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A SUMMARY OF THE EPA NATIONAL SOURCE PERFORMANCE AUDIT PROGRAM - 1980

by

R. G. Fuerst, E. W. Streib and M. R. Midgett
Quality Assurance Division
Environmental Monitoring Systems Laboratory
U. S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27711

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A national quality assurance audit program for methods used in stationary source tests was conducted in 1980 by the Quality Assurance Division of the Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina. In this program, quality assurance materials were sent to interested participants for the measurement of a gas volume (Method 5, dry gas meter only) or the analysis of liquid samples simulating collected sulfur dioxide and nitrogen oxides (Method 6 and 7, respectively). Each participant returned the analytical results to the Source Branch, Quality Assurance Division, for evaluation. An individual report was returned to each participant after processing.

This report summarizes the audit results of 1980 for those three source test methods.

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FOREWORD

Measurement and monitoring research efforts are designed to anticipate potential environmental problems, to support regulatory actions by developing an in-depth understanding of the nature and processes that impact health and the ecology, to provide innovative means of monitoring compliance with regulations, and to evaluate the effectiveness of health and environmental protection efforts through the monitoring of long-term trends. The Environmental Monitoring Systems Laboratory, Research Triangle Park, North Carolina, has responsibility for: assessment of environmental monitoring technology and systems; implementation of agency-wide quality assurance programs for air pollution measurement systems; and supplying technical support to other groups in the Agency including the Office of Air, Noise and Radiation, the Office of Toxic Substances, and the Office of Enforcement.

The major task of this study was to report the results of the national quality assurance audit program for stationary source test methods. Audits were designed to estimate the minimal analytical and computational accuracy that can be expected with EPA Method 5 (dry gas meter only), Method 6 (sulfur dioxide) and Method 7 (nitrogen oxides). Statistical analysis was used to characterize the data.

Thomas R. Hauser, Ph.D.
Director
Environmental Monitoring Systems Laboratory
Research Triangle Park, North Carolina

ABSTRACT

A national quality assurance audit program for methods used in stationary source tests was conducted in 1980 by the Quality Assurance Division of the Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina. In this program, quality assurance materials were sent to interested participants for the measurement of a gas volume (Method 5, dry gas meter only) or the analysis of liquid samples simulating collected sulfur dioxide and nitrogen oxides (Method 6 and 7, respectively). Each participant returned the analytical results to the Source Branch, Quality Assurance Division, for evaluation. An individual report was returned to each participant after processing.

This report summarizes the audit results of 1980 for those three source test methods.

CONTENTS

Foreword iii
Abstract iv
Figures vi
Tables vii
Acknowledgments viii

1. Introduction 1
2. Summary 3
3. Recommendations 5
4. Audit Design 6
   Audit procedures 6
   Prospective participants 7
   Preparation and distribution of audit materials for methods 5, 6, and 7 7
5. Performance Criteria 9
6. Discussion of Method 5 Audit Results 10
7. Discussion of Method 6 Audit Results 18
8. Discussion of Method 7 Audit Results 23

References 31
Appendices

A. Method 5 DGM data summary 32
B. Method 6 SO_2 data summary 36
C. Method 7 NO_x data summary 46
D. Instructions for use of the audit materials 56

FIGURES

Number		Page
1	Method 5 Audits 0280 and 0880 cumulative number distribution	12
2	Method 5 Audit 0280, cumulative number distribution of percent standard deviation	14
3	Method 5 Audit 0880, cumulative number distribution of percent standard deviation	15
4	Method 5 Previous audit results (degree of accuracy 2 and 5%)	17
5	Method 6 Audit 0380 and 0980 cumulative percent distribution	20
6	Method 6 Previous audit results - low concentration (degree of accuracy 2 and 5%)	21
7	Method 6 Previous audit results - high concentration (degree of accuracy 2 and 5%)	22
8	Method 7 Audits 0480 and 1080 cumulative percent distribution	25
9	Method 7 Audit 1080 K_c values	26
10	Method 7 Audit 1080 histogram of K_c values	27
11	Method 7 Previous audit results - low concentration (degree of accuracy 5 and 10%)	29
12	Method 7 Previous audit results - high concentration (degree of accuracy 5 and 10%)	30

TABLES

Number		Page
1	Method 5 Audit 0280 - Laboratory Distribution	10
2	Method 5 Audit 0880 - Laboratory Distribution	10
3	Method 6 Audit 0380 - Laboratory Distribution	18
4	Method 6 Audit 0980 - Laboratory Distribution	18
5	Method 7 Audit 0480 - Laboratory Distribution	23
6	Method 7 Audit 1080 - Laboratory Distribution	23

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SECTION 1

INTRODUCTION

To control the amount of contamination emitted to our atmosphere from stationary sources, the Environmental Protection Agency (EPA) promulgated on December 23, 1971, the first five of its New Source Performance Standards (1). These regulations gave EPA the power to enforce certain emission limitation levels using specific source test methodology. But with any type of compliance testing, validity of the data must be shown. This is accomplished through a quality assurance program.

To assist in this type of program, the Environmental Monitoring Systems Laboratory (EMSL) of EPA established in 1977 a nationwide performance audit program (2) to insure that source emission data collected for compliance determination purposes are accurate and reliable. This program had three main purposes:

1) To verify that the analytical and computational parts of the specific reference methods were being properly used.

2) To improve the accuracy of the measurement being made by providing individual performance reports with the availability of practice sample sets.

3) To aid the participating laboratories in assessing their analytical performance relative to that of other laboratories conducting similar analyses by providing annual data summary reports.

These goals were realized by sending specific performance materials to interested laboratories for analysis.

In the semiannual source test method audits conducted in the spring and fall of 1980, the technique of volume measurement by a dry gas meter was examined. This measurement is essential to Methods 5, 8, 12, 13, and 17 (3). Also examined were the analytical and computational parts of Method 6 for sulfur dioxide (SO_2) (4) and Method 7 for nitrogen oxides (NO_x) (5). This report describes the preparation and evaluation of these tests.

SECTION 2

SUMMARY

EPA's National Quality Assurance Audit Program for Stationary Source Test Methods was conducted in the spring and fall of 1980. The methods examined were Method 5 (dry gas meter only), Method 6 (SO_2) and Method 7 (NO_x). The audits were conducted by the Quality Assurance Division (QAD) of EPA's Environmental Monitoring Systems Laboratory located in the Research Triangle Park, North Carolina. They involved laboratories from industry, contracting firms, universities, foreign countries, and governmental agencies.

A summary of the Method 5 data shows that an average of 75% of the 303 laboratories that requested samples returned data for the spring (0280) and fall (0880) studies. Comparing the reported results from these laboratories to the 2% Federal Register specification for dry gas meter accuracy (6), we find that in Audit 0280, 34% of the laboratories came within 2% of the EPA value, while in Audit 0880, 42% of the laboratories were able to do so. Seventy-five of the 111 laboratories that participated in the spring audit also participated in the fall audit.

A summary of Method 6 data shows an average of 70% of the 290 laboratories requesting samples returned data for the spring (0380) and fall (0980) studies. Of those laboratories reporting data, 50% of the laboratories came within an average of 1.6% of the EPA value for the 5 samples in Audit 0380. For the 0980 audit they came within 1.9%. Seventy-six of the 102 laboratories that participated in the spring audit also participated in the fall audit.

A summary of Method 7 data shows an average of 58% of the 240 laboratories requesting samples returned data for the spring (0480) and fall (1080) audits. Of those laboratories returning data, 50% were able to come within an average of 5.3% of the EPA value for the 5 samples in Audit 0480, while

in Audit 1080 they came within 6.4%. Forty-nine of the 70 laboratories that participated in the spring audit also participated in the fall audit.

To examine previous audit data for trends, a certain degree of accuracy was chosen and plotted for each method. They were: 2 and 5 percent accuracy for Method 5 and 6, and 5 and 10 percent accuracy for Method 7.

Use was made in this report of an outlier test (Chauvenet's Criterion) to determine the values that lie outside the bulk of the collected data.

SECTION 3

RECOMMENDATIONS

To create a sample repository, the Quality Assurance Division of the Environmental Monitoring Systems Laboratory intentionally produced an oversupply of samples for the audits of EPA Methods 6 and 7 discussed in this report. These stable samples are available to any laboratory having a legitimate need for them, such as training new analysts and conducting periodic external quality control checks of the laboratory. Included with these practice samples is a statement of true concentration with no requirement for return of data to EPA. We recommend that all participants make use of this sample repository to increase their overall analytical skills with typical Method 6 and 7 samples.

SECTION 4

AUDIT DESIGN

The source sample audit program discussed in this report incorporates the experience gained from previous audits in areas such as procedures, prospective participants, categorization and preparation of audit materials, and data handling.

AUDIT PROCEDURES

All audits began with a master list of prospective laboratories which had in the past participated in or indicated a wish to take part in such a program.

Prospective participants were sent an invitation to participate plus a description of the source methods being audited with instructions for participation. Through a response card, which is included with the invitation, each laboratory indicated if it wished to participate. Response cards were returned to the Source Branch (SB), QAD/EMSL which collected, logged, and forwarded a list of the participants to the EPA contractor preparing the audit materials for QAD. All participating laboratories are assigned an identification number to facilitate storage of their data in the computer's data bank and to maintain confidentiality of each participant's results. At a prearranged date, requested audit materials were shipped to the participants with the instructions for sample analysis, a blank data card to report the completed analysis values, and a mailing label for return of the data card to QAD. After the data are reported to QAD, the participants receive a computer data sheet containing the results of their performances compared to the QAD accepted values for each sample. At the completion of each year, a summary of the total results will be published without reference to specific laboratories.

PROSPECTIVE PARTICIPANTS

Using a previously compiled master list of laboratories from past audits, invitations to participate in the semiannual source audit program for spring and fall of 1980 were sent to all volunteers who had previously participated in the audit program. Other laboratories were added to the master list through their direct contact with the SB/QAD or the Regional Quality Control Coordinator (RQCC).

PREPARATION AND DISTRIBUTION OF AUDIT MATERIALS FOR METHODS 5, 6, AND 7

To provide a check on the calibration of the dry gas meter used in the Method 5 stack sampling train, a critical orifice device was developed to pass a certain flow rate of air through the dry gas meter when the measured vacuum on the orifice was at least 16 inches of mercury. This device allows an analyst to compare a volume measured at his location with one measured at an EPA location. Volumes measured at both locations are compared to the original calibration of the device with the effects of ambient temperature and pressure on the measurements taken into account. After initial calibration by an EPA contractor, each device is recalibrated by EPA laboratory personnel, who reject any device whose volume measurement does not fall within ± 2% of the original calibration. This process of verification of the original calibration is known as Acceptance Testing.

Participants in the Method 5 audit were instructed to insert the critical orifice device in the probe connection of their gas sampling meter box, and, after a warmup period, to take three 15 minute volume measurements. Using Equation 5-1 of Method 5 (3), they were to calculate each of the three volumes in cubic meters and record the volumes on the data card along with other pertinent information concerning sampling conditions. Participants were then to mail the device and data card to EPA for comparison of volumes. Since some meter boxes had diaphragm pumps that could not pull the 16 inches of mercury vacuum necessary to produce critical flow with the standard orifice, smaller orifices were constructed to allow the pumps to pull the required vacuum. All orifices are recalibrated upon return to EPA.

For the audits of Methods 6 and 7, five different concentration levels of simulated source SO_2 and NO_x samples were prepared for the participants to analyze and calculate using Methods 6 and 7. The true values of these samples were based on theoretical concentrations calculated from gravimetric preparations and certain assumed volume measurements. After sample solutions were made, their concentrations were verified with ion-chromatographic methods. Because the audit solutions contained only the species to be identified, this very accurate procedure could be used in place of the reference method. This verification step was initially conducted by contractor personnel and then by EPA personnel, via Acceptance Testing.

Approximately 20 ml of each Method 6 and Method 7 sample solution was sealed in a 25 ml glass ampoule, and five different concentration levels were shipped to the participating laboratories. The ampoules containing NO_x samples were autoclaved to destroy bacteria that might possibly attack the solutions.

Instructions for the Method 6 samples prescribed that 5 ml of the test solution be diluted to 100 ml through the addition of 30 ml of 3% hydrogen peroxide (H_2O_2) and distilled water. An aliquot of this solution was then titrated with barium perchlorate ($Ba[ClO_4]_2$) in the presence of thorin indicator to the characteristic peach color endpoint. Barium chloride ($BaCl_2$) is also an acceptable alternative titrant. To complete Method 6 calculations, the participants assumed they had an original sample volume of 100 ml, and had sampled 21×10^{-3} DSCM (dry standard cubic meter) of stack gas.

The analysis of Method 7 samples involved dilution of a 5 ml aliquot of the original test sample with 25 ml of absorbing reagent, adjustment of the pH to between 9 and 12, followed by dilution to 50 ml with distilled water. After a digestion procedure, a colorimetric analysis followed. To complete Method 7 calculations, the participants assumed they had sampled 2000 ml of stack gas.

The audit instructions for all three methods are contained in Appendix D. In each audit, the samples were number coded. The key for the five concentration levels was based on the first digit of the sample number.

SECTION 5

PERFORMANCE CRITERIA

Establishment of performance criteria so that each participating laboratory can evaluate their reported data is a major part of any quality assurance program. Setting performance criteria is a somewhat arbitrary process, however, because the criteria are based either on previously reported data or on certain expected results.

In our program the performance criteria are based on data from previous audits. In this way laboratories can compare their reported results with the results of other laboratories analyzing similar samples.

These performance ranges are displayed through use of frequency distributions of percent difference. The frequency distribution data compare the percent difference between all reported sample results with the QAD accepted value for each sample.

Although statistical comparisons are made between different audits for different years for the same pollutant, each laboratory participating in an audit can use different analysts for each audit. Thus, any increase in overall accuracy could mean the analysts are becoming more familiar with the methods, or that more competent analysts are being used.

The statistical outlier test, Chauvenet Criterion (7), was used here to identify reported values that lie outside the bulk of the data. "Chauvenet's Criterion" is based on the normal distribution and advises rejection of an extreme observation if the probability of occurrence of such deviation from the mean of the n measurements is less than 1/2 n.

SECTION 6

DISCUSSION OF METHOD 5 AUDIT RESULTS

The distribution of the types of laboratories responding to Audits 0280 and 0880 regarding Method 5 (dry gas meter only) is shown in Tables 1 and 2 below.

TABLE 1. METHOD 5 AUDIT 0280

	Laboratory Type Distribution						
	Contractor	Industrial	Foreign	Federal	State	Local	Total
Laboratories requesting samples	83	36	4	4	17	7	151
Laboratories returning data	61	24	3	4	14	5	111

TABLE 2. METHOD 5 AUDIT 0880

	Laboratory Type Distribution						
	Contractor	Industrial	Foreign	Federal	State	Local	Total
Laboratories requesting samples	87	36	3	5	16	5	152
Laboratories returning data	66	29	2	2	12	3	114

About 25% of participants requested audit samples but did not analyze and return their data in these two source audits. Probable causes for not

returning data are either conflicts with scheduled work or oversights, that is, failure to schedule the analysis of the QA samples during the alloted time period. These two reasons would not bias the statistics of an audit. However, if the sample results were not returned because of suspected inaccuracy of the data, the audit statistics would be biased. Without extensive examination the reason for non-return of data cannot be determined in a volunteer audit program.

In case analytical problems do arise, the audit participant may obtain practice audit samples with their specific volumes (Method 5) or concentrations (Method 6 or 7) listed.

Participants in the Method 5 audit were instructed to take three 15 minute volume measurements, calculate each volume at standard conditions in cubic meters using Equation 5-1 of Method 5, and report their results on the blank data card provided.

Since the compared results have been reported in percents, the participant can readily discover his standing in the overall group of participants by examining the data in Appendix A. The data in Appendix A represent absolute percent difference, which has been calculated as follows:

$$APD = \frac{RV - TV}{TV} \times 100 \qquad (1)$$

where: APD = absolute percent difference
RV = reported value
TV = true value
100 = factor to change decimal to percent

The cumulative number distribution of laboratories in Figure 1 displays the accuracy obtained in the Method 5 Audits 0280 and 0880 when the reported values are compared against the true value determined by EPA. The Code of Federal Regulations (6) requires that the dry gas meter for Method 5 be accurate to ± 2%. In Figure 1 we find only 34 and 42 percent (respectively) of the laboratories making these measurements in both audits were able to come within 2 percent of volume.

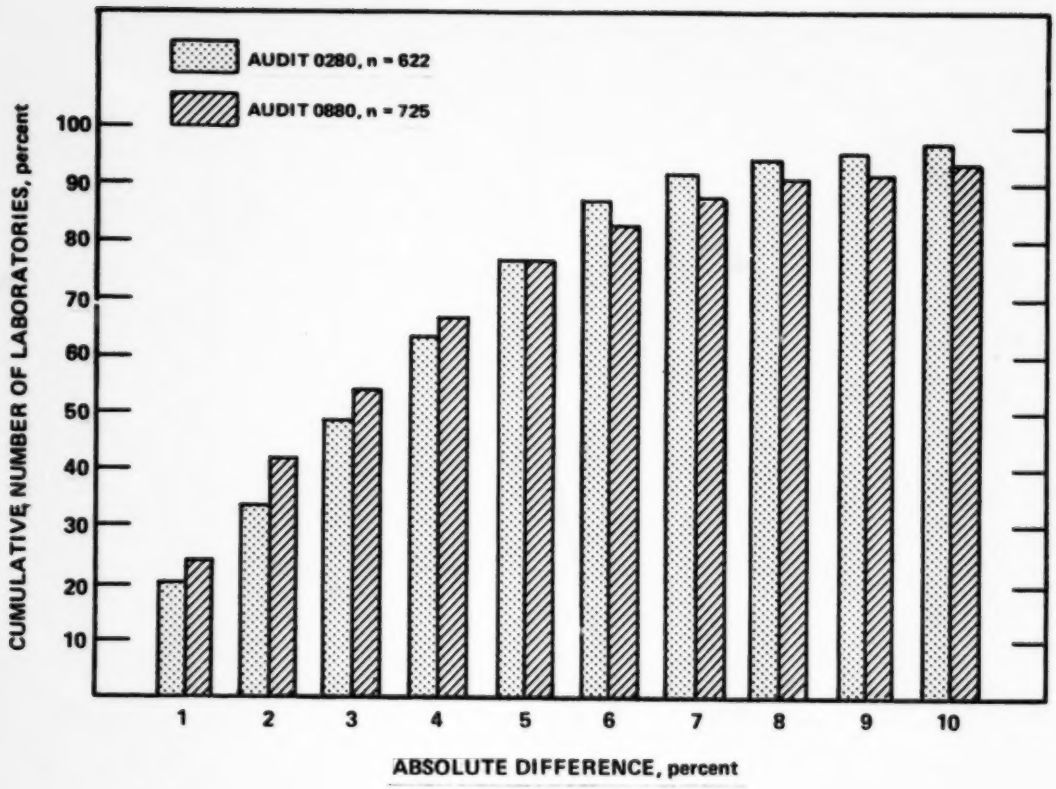

Figure 1. Method 5 Audits 0280 and 0880 cumulative number distribution.

Three cumulative number distributions of the reported data are displayed in Appendix A.

(a) the first distribution displays the statistics generated from all the reported data of the specific audit;

(b) the second distribution uses the same data as in (a), but with one pass of the outlier test;

(c) the third distribution uses the same data as in (a) except with multiple passes of the outlier test. (Multiple passes are repeated use of an outlier test until no more values are removed.) This procedure provides a homogeneous data set. Because this outlier test operates through use of a factor (based on the number of determinations) times the standard deviation, some extraneous data can still exist in the data set even after one pass of an outlier test.

Precision determined from calculating the standard deviation of each triplicate set (Figures 2 and 3) shows that in Audit 0280, 70% of the 207 triplicate sets had a standard deviation of 0.3% or less. In Audit 0880, 68% of the 240 triplicate sets were able to do this.

Calculating a signed percent difference from Audit 0280 data we find that 76% of the measured volumes fell below the EPA value with a mean and standard deviation of all data being -2.0% ± 7.4%. In Audit 0880, 68% fell below the EPA value with a mean and standard deviation of -1.6% ± 7.4%. A negative bias can be caused by leakage in the wet test meter or the dry test meter. There are several helpful publications (8,9,10) on troubleshooting these test meters. Before EPA will accept an orifice, its calibration must agree within ± 2% of its original value; otherwise, it is returned to the contractor for cleaning and recalibration. Although the volume determinations made with the meter boxes are expected to be within ± 2%, all participants' values have been compared to the original contractor calibration.

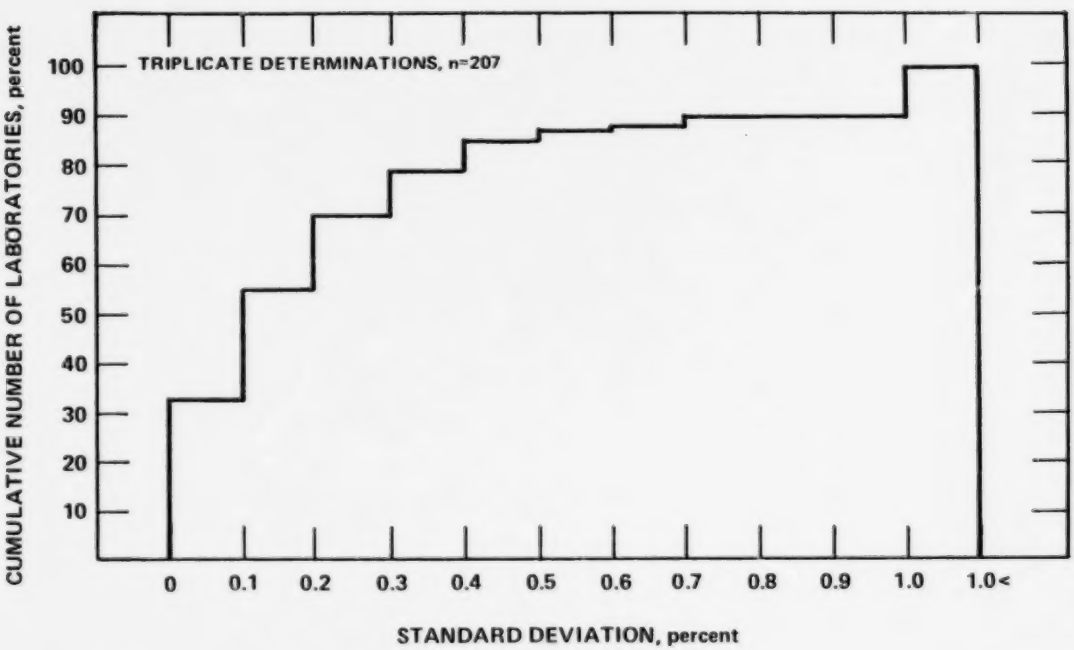

Figure 2. Method 5 Audit 0280 cumulative number distribution of percent standard deviation.

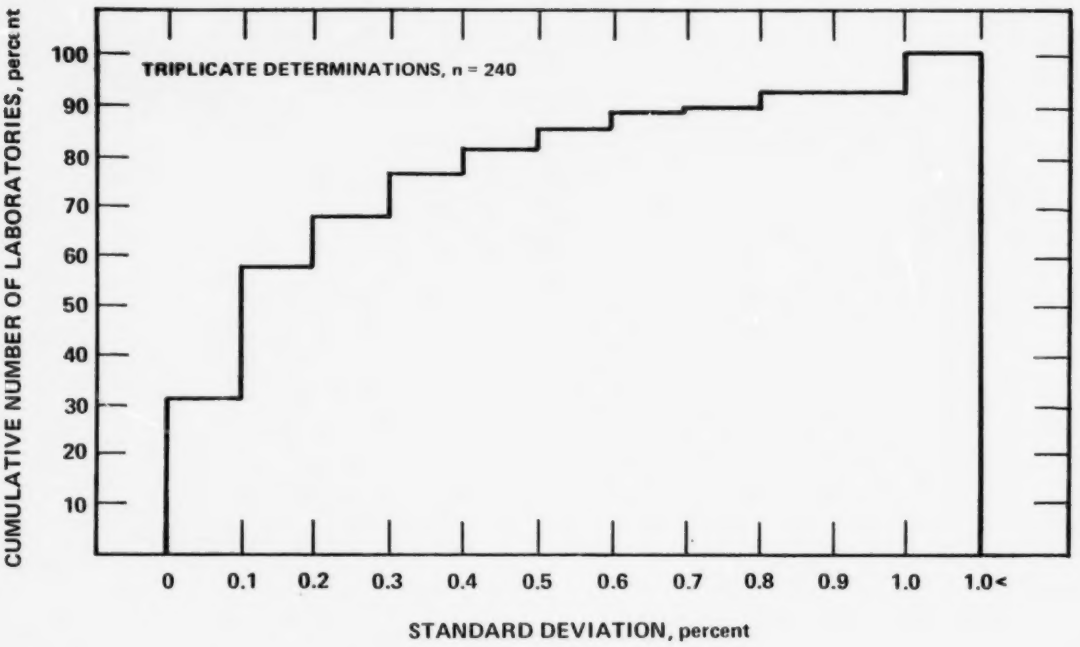

Figure 3. Method 5 Audit 0880 cumulative number distribution of percent standard deviation.

All participants should use Figures 1, 2 and 3 for self-evaluation; each laboratory can set its own expected accuracy and precision based on what others are doing under similar circumstances. To add continuity to the data base for comparison purposes, 75 of the 111 laboratories that returned data in the 0280 audit also returned data in the 0880 audit.

Since the mean and median values were close, and since skewness (reflecting the asymmetry of the data), was low (-0.84 for Audit 0280, and -0.72 for Audit 0880), the data were treated as normally distributed. (Normally distributed data is a basic assumption for the use of Chauvenet's Criterion outlier test.)

Examining previous audit data for Method 5 (Figure 4) we find a gradual increase in the percent of laboratories able to measure within 2 and 5 percent of the EPA value. From the 0379 Audit onward a plateau is occurring in both figures while maintaining a steady increase in the number of measurements made.

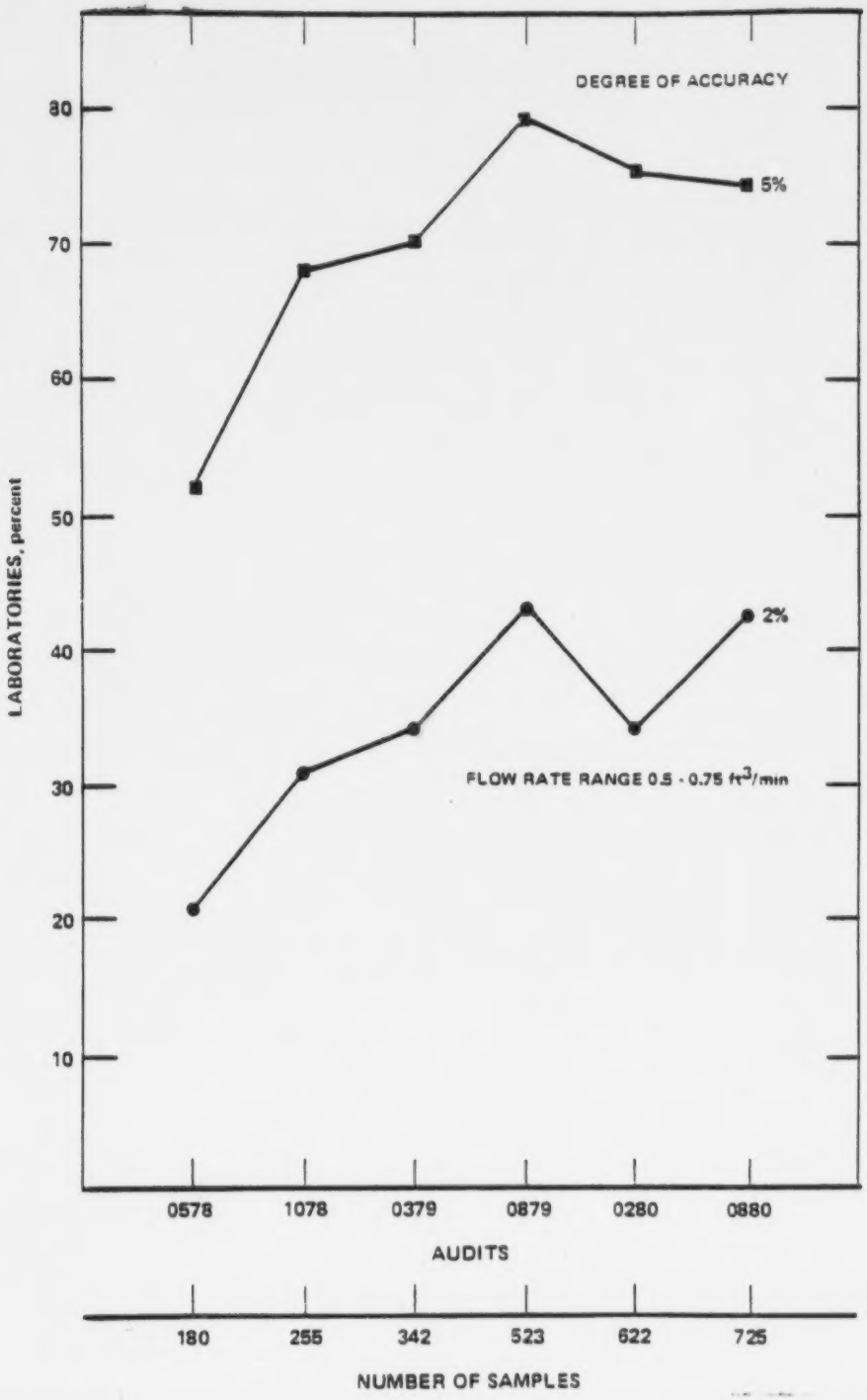

Figure 4. Method 5 previous audit results (degree of accuracy 2 and 5 percent).

SECTION 7
DISCUSSION OF METHOD 6 AUDIT RESULTS

The distribution of participants in the Method 6 audits 0380 and 0980 is shown in Tables 3 and 4 below.

TABLE 3. METHOD 6 AUDIT 0380

	Laboratory Type Distribution							
	Contractor	Industrial	Foreign	Federal	State	Local	University	Total
Laboratories requesting samples	85	34	2	1	18	8	0	148
Laboratories returning data	56	23	2	1	13	7	0	102

TABLE 4. METHOD 6 AUDIT 0980

	Laboratory Type Distribution							
	Contractor	Industrial	Foreign	Federal	State	Local	University	Total
Laboratories requesting samples	85	29	3	3	15	7	0	142
Laboratories returning data	56	21	3	1	12	7	0	100

Participants were instructed to use Method 6 for all analyses and report their results (mg SO_2/DSCM), based on Equation 6-2 of Method 6 (3), on a blank data card.

Figure 5 is a frequency distribution depicting the data collected from the Method 6 audits 0380 and 0980. Each decade percent line is made up of five points, which are plots of the absolute percent difference and which represent the results of a particular percentage of the laboratories. The samples are listed for each audit in order of increasing concentration level from left to right. As an example, using the 0380 audit data plot we find that 50% of the participants analyzing the lowest sample concentration (#2 = 305.0 mg SO_2/DSCM) were 2.0% or less from the EPA value. In Audit 0980, 50% of the participants analyzing its lowest concentration sample (#8 = 381.3 mg SO_2/DSCM) were 2.7% or less from the EPA value.

Examining Figure 5 for trends we find in the results of both audits that as the sample concentration increases the analysts did better (obtained lower percent difference value) at all levels except the 90% level where the results were affected by outlying values. To provide continuity to the data base for comparison purposes, 76 of the 102 laboratories that reported results in Audit 0380 also reported data in Audit 0980.

A plot of low and high concentration range samples (Figures 6 and 7) from previous audit results shows a slight trend toward improvement in accuracy at the 2 and 5 percent accuracy levels with the lower concentration samples (137-381 mg SO_2/DSCM), while showing a decreasing trend in accuracy at the same accuracy levels with the higher concentration samples (2097-2592 mg SO_2/DSCM).

These plots were made from all report data (no outliers were removed). Removal of outlying values would improve the number of laboratories coming within accuracy levels by decreasing the total number of samples. The total number of analyses has doubled since the beginning of the Method 6 audit program in May of 1977.

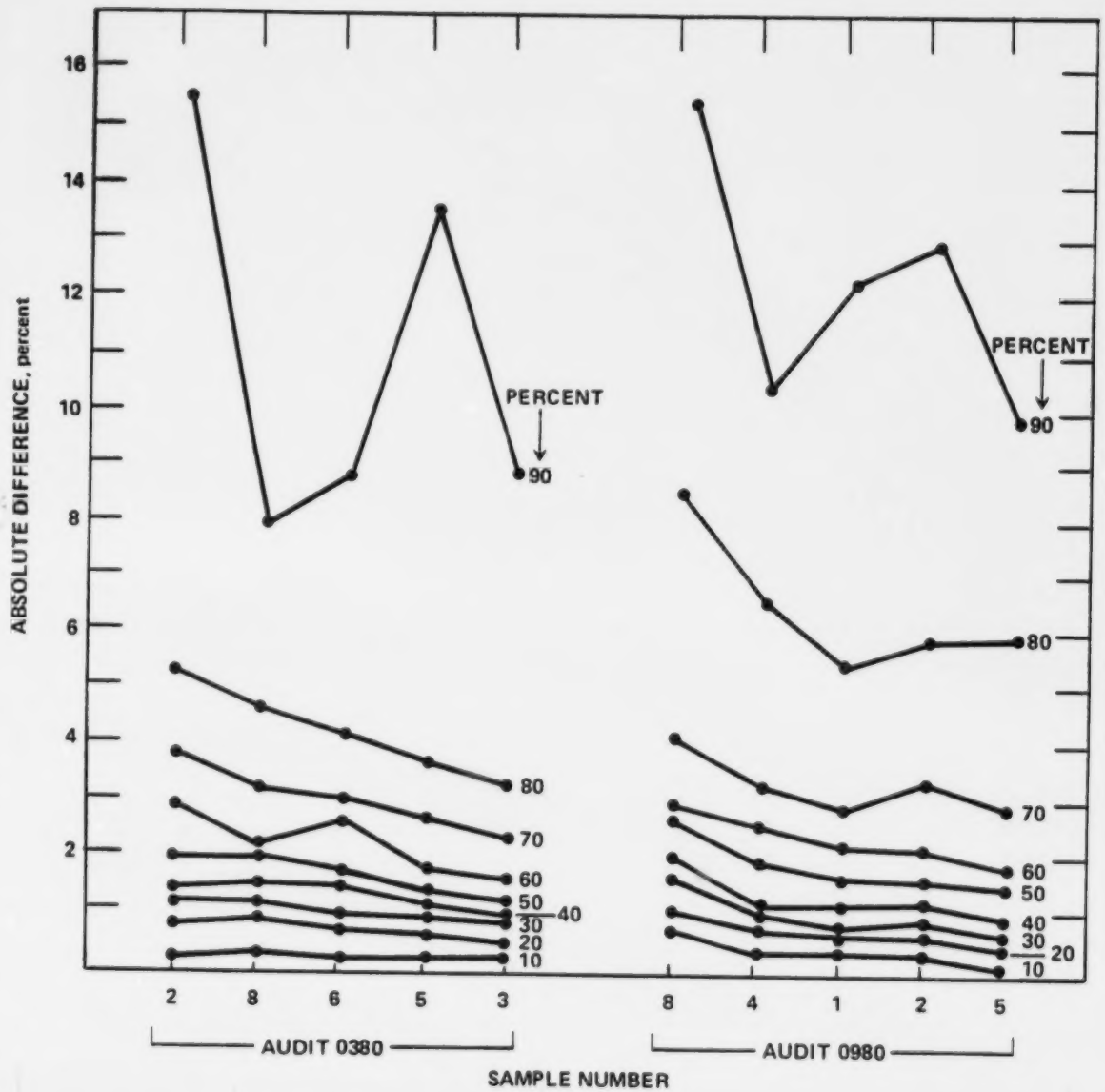

Figure 5. Method 6 Audit 0380 and 0980 cumulative percent distribution.

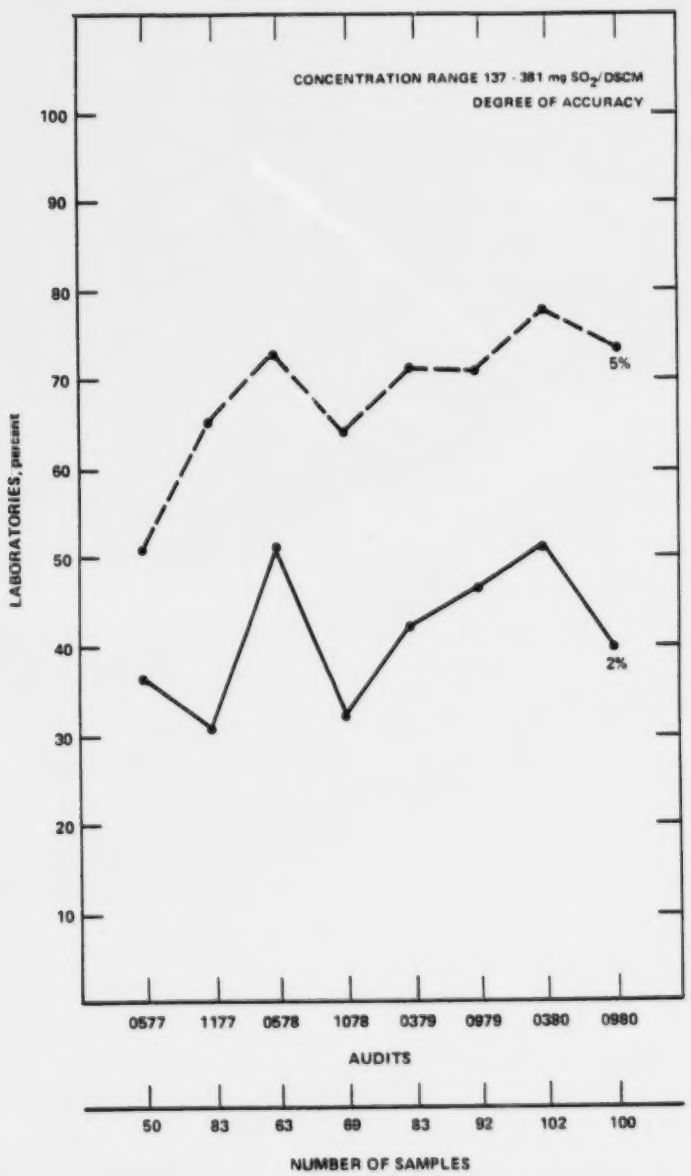

Figure 6. Method 6 previous audit results - low concentration (degree of accuracy 2 and 5 percent)

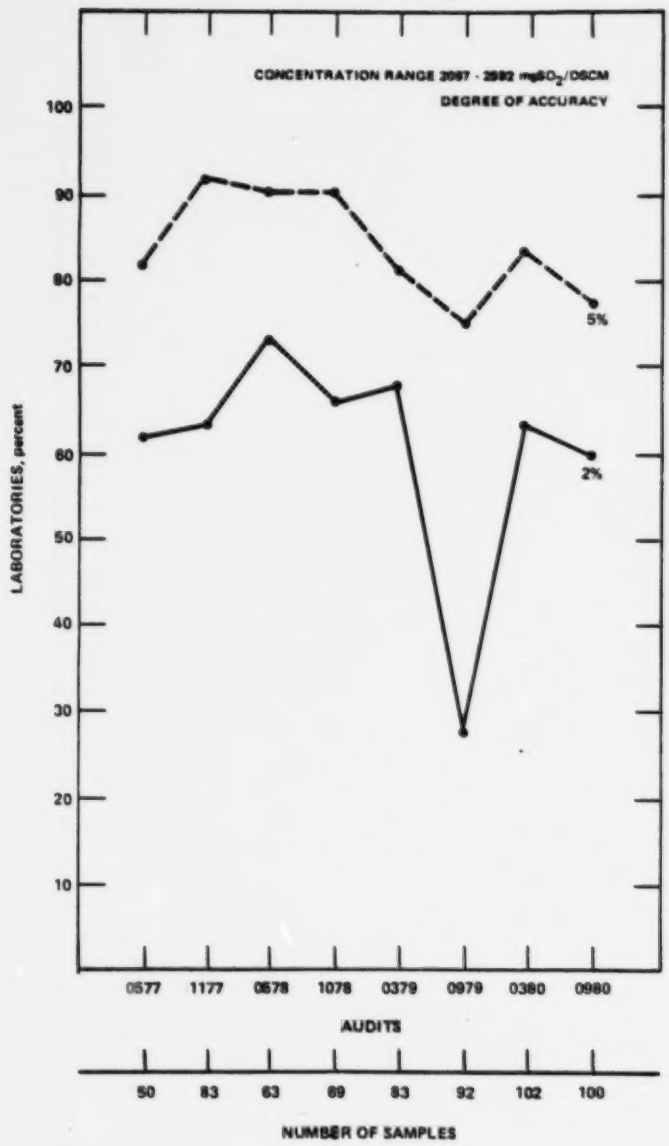

Figure 7. Method 6 previous audit results - high concentration (degree of accuracy 2 and 5 percent).

SECTION 8

DISCUSSION OF METHOD 7 AUDIT RESULTS

Tables 5 and 6 (below) show the distribution of samples in Audits 0480 and 1080 for the NO_x method.

TABLE 5. METHOD 7 AUDIT 0480

	Laboratory Type Distribution							
	Contractor	Industrial	Foreign	Federal	State	Local	University	Total
Laboratories requesting samples	77	25	2	1	12	7	0	124
Laboratories returning data	38	15	2	1	9	5	0	70

TABLE 6. METHOD 7 AUDIT 1080

	Laboratory Type Distribution							
	Contractor	Industrial	Foreign	Federal	State	Local	University	Total
Laboratories requesting samples	76	19	3	3	10	5	0	116
Laboratories returning data	43	15	1	1	6	4	0	70

Participants were instructed to use Method 7 (5) for the analysis and report their results based on Equation 7-4 of the method as mg NO_x/DSCM. Under the section called Calculations in Method 7, the analyst was instructed to report the concentration of the NO_x samples as NO_2.

Figure 8 is a frequency distribution of this year's Method 7 audit results. This figure places the samples in increasing concentration from left to right for each audit. The data were plotted this way to determine if any sample gave more trouble to the analyst than any other. This is determined by a consistently higher percent difference at each of the percent levels. In Audit 0480 only at the 90% level does any noticeable percent difference show, and that is due mainly to outlying values. In Audit 1080 most analysts had more trouble with sample #9 (99.4 mg/DSCM) than with any other sample at each level. Again the 90% level shows the effects of outlying values.

The participant can use these diagrams to locate his placement among others who have analyzed similar samples. Appendix C contains all the reported Method 7 data used to develop the summary statistics. To provide continuity to the data base for comparison purposes, 49 of the 70 laboratories that returned data in Audit 0480 also returned data in Audit 1080.

With the Method 7, Audit 1080, the participants were asked to report their calibration factor (K_c) determined from calculations using equation 7-1 of the Method 7 procedure. This equation is used to develop a slope of a line generated from the correlation between the prepared standards and their absorbances that will pass through zero. We intended by obtaining this information to correlate the K_c values with the percent difference values in order to develop specifications for an optimum K_c value. Seventy-four percent (52) of the labs reporting data (Table 6) listed their K_c value. Figure 9 shows a plot of points comparing K_c values with the average percent difference values. The five percent difference values calculated from the reported values for each lab make up the average percent difference value. All K_c values above 1000 and all percent differences of 40 were plotted on the boundary line. Examining this figure we find 62 percent of the reported values were greater than the EPA values. We also find a density of points around the 600-850 K_c value range. Plotting a histogram of the K_c values (Figure 10) shows that 57 percent of all reported K_c values fell within 650-800. With this range in mind, we re-examined Figure 9 and found that 60 percent of those reporting K_c

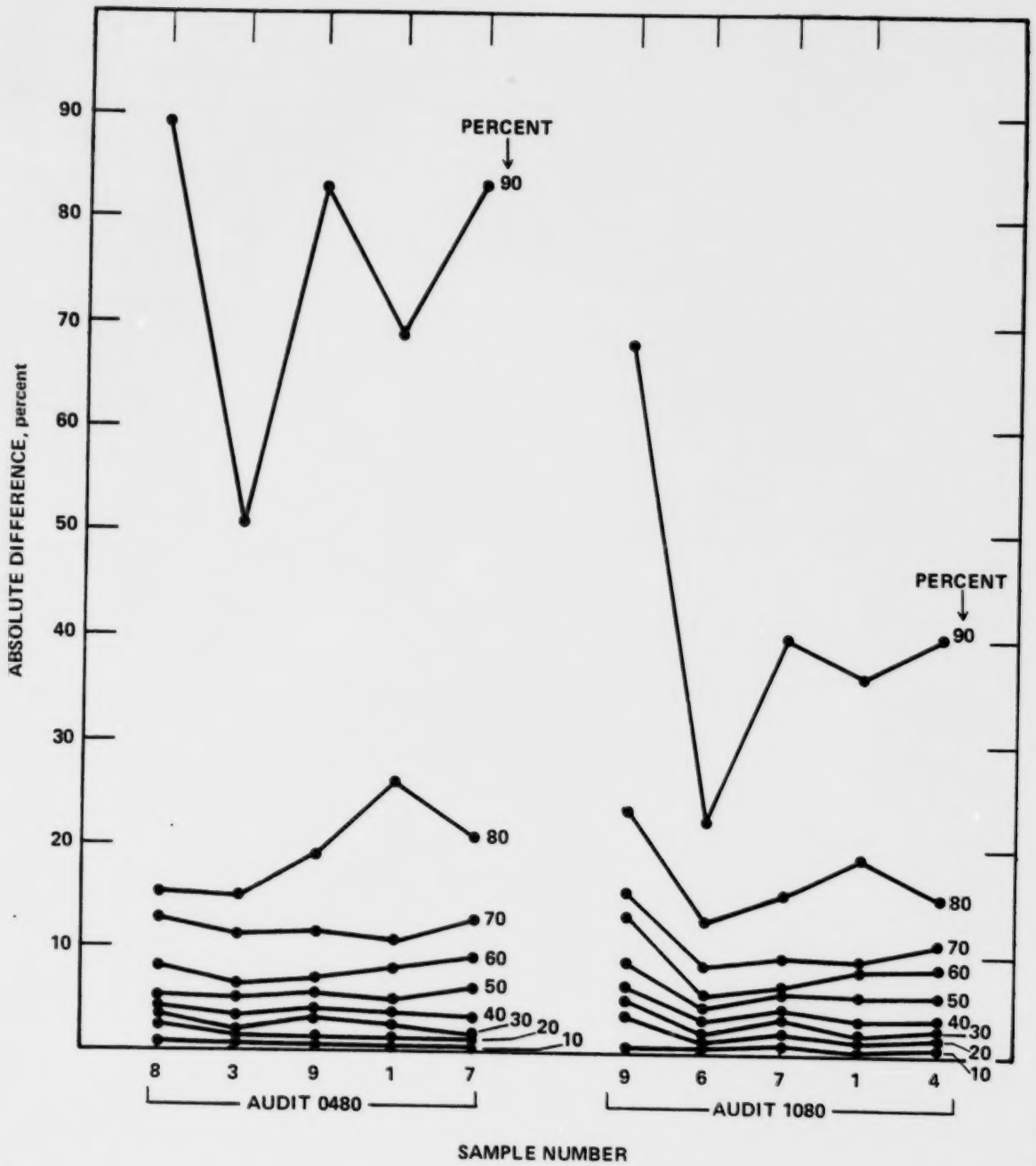

Figure 8. Method 7 Audits 0480 and 1080 cumulative percent distribution.

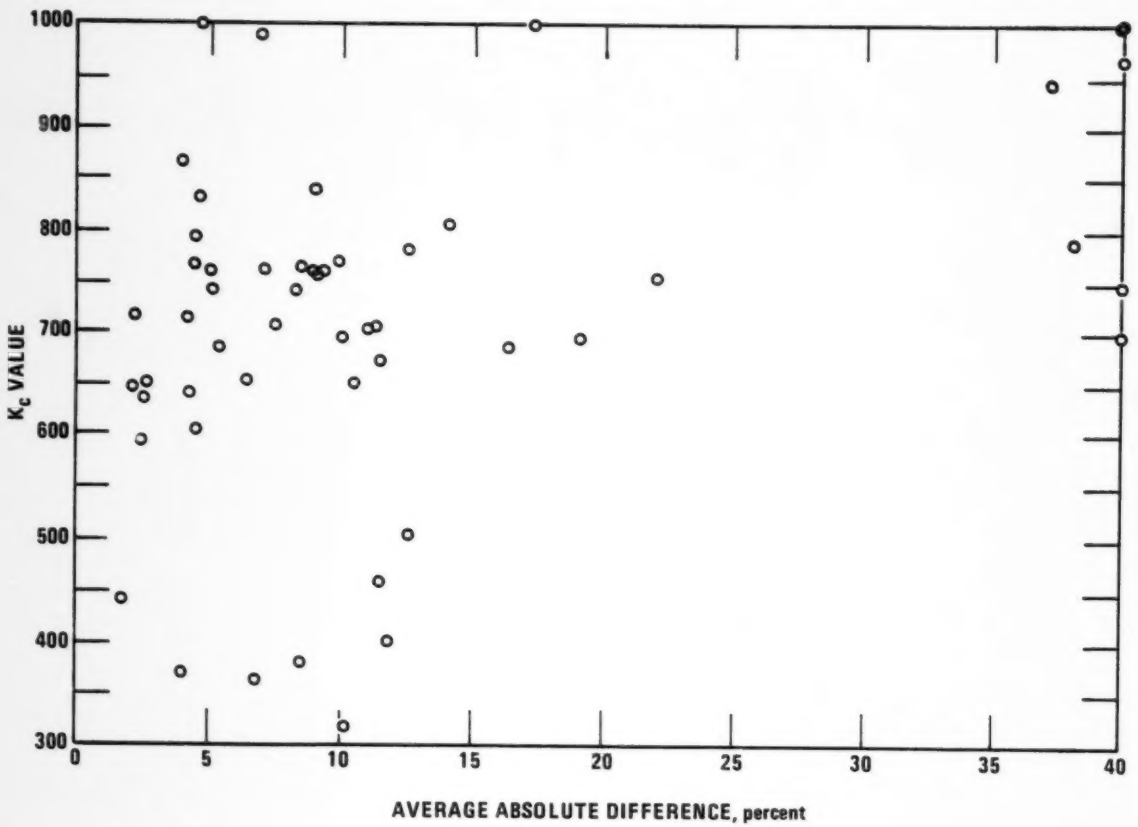

Figure 9. Method 7 Audit 1080 K_c values.

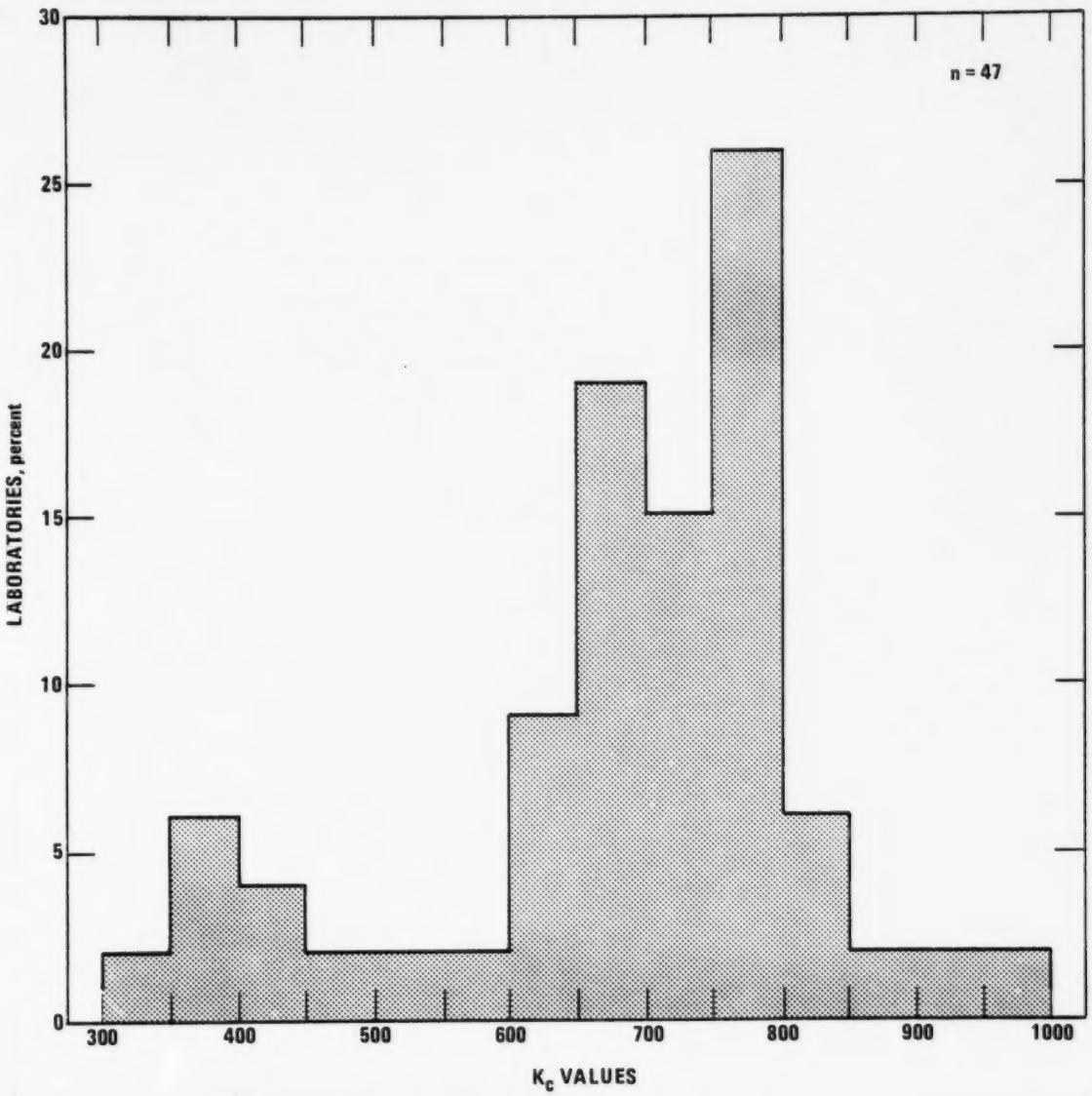

Figure 10. Method 7 Audit 1080 histogram of K_c values.

values in that range came within 10 percent of the EPA value, while 52 percent came within 5 percent. With these limited data, we find that:

1) everyone is not using the standard concentrations as suggested in the Federal Register;

2) some labs are able to come close to the EPA value while having a K_c = 300 or 1000. This would suggest different aliquots of the samples and standards are being taken, or different cell path lengths are being used; and

3) an optimum K_c value should fall within 650 to 800 if Method 7 is followed exactly.

EPA will continue to collect this type data to distinguish if the K_c or a least squares regression specification can improve accuracy using this method.

Examining previous Method 7 audit results for trends using a low and a high sample concentration level (Figures 11 and 12), we find no increase or decrease at either the 5 or 10 percent degrees of accuracy. Therefore, the analysts did as well when analyzing low or high concentration samples at the same accuracy level.

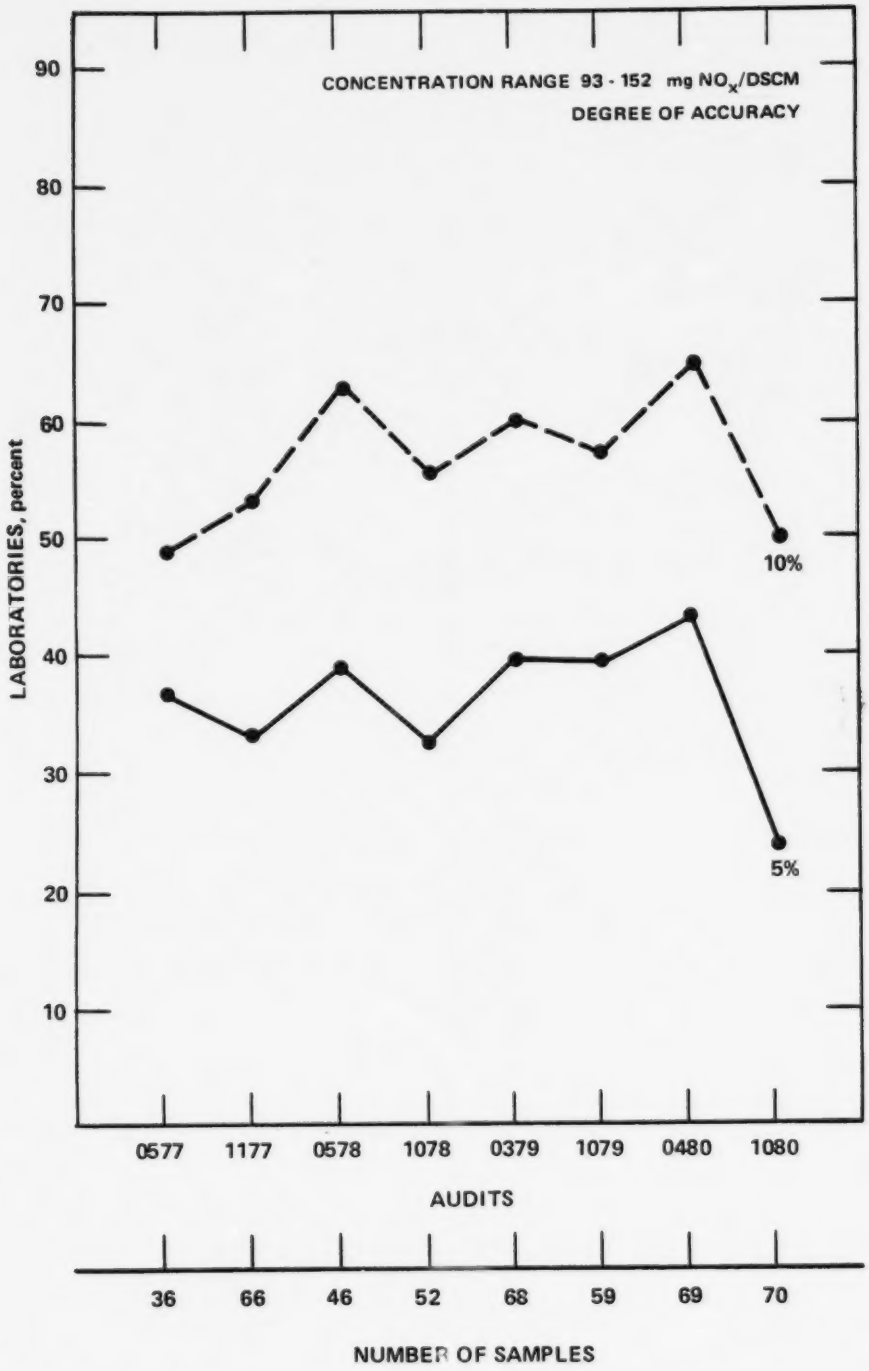

Figure 11. Method 7 previous audit results - low concentration (degree of accuracy 5 and 10 percent).

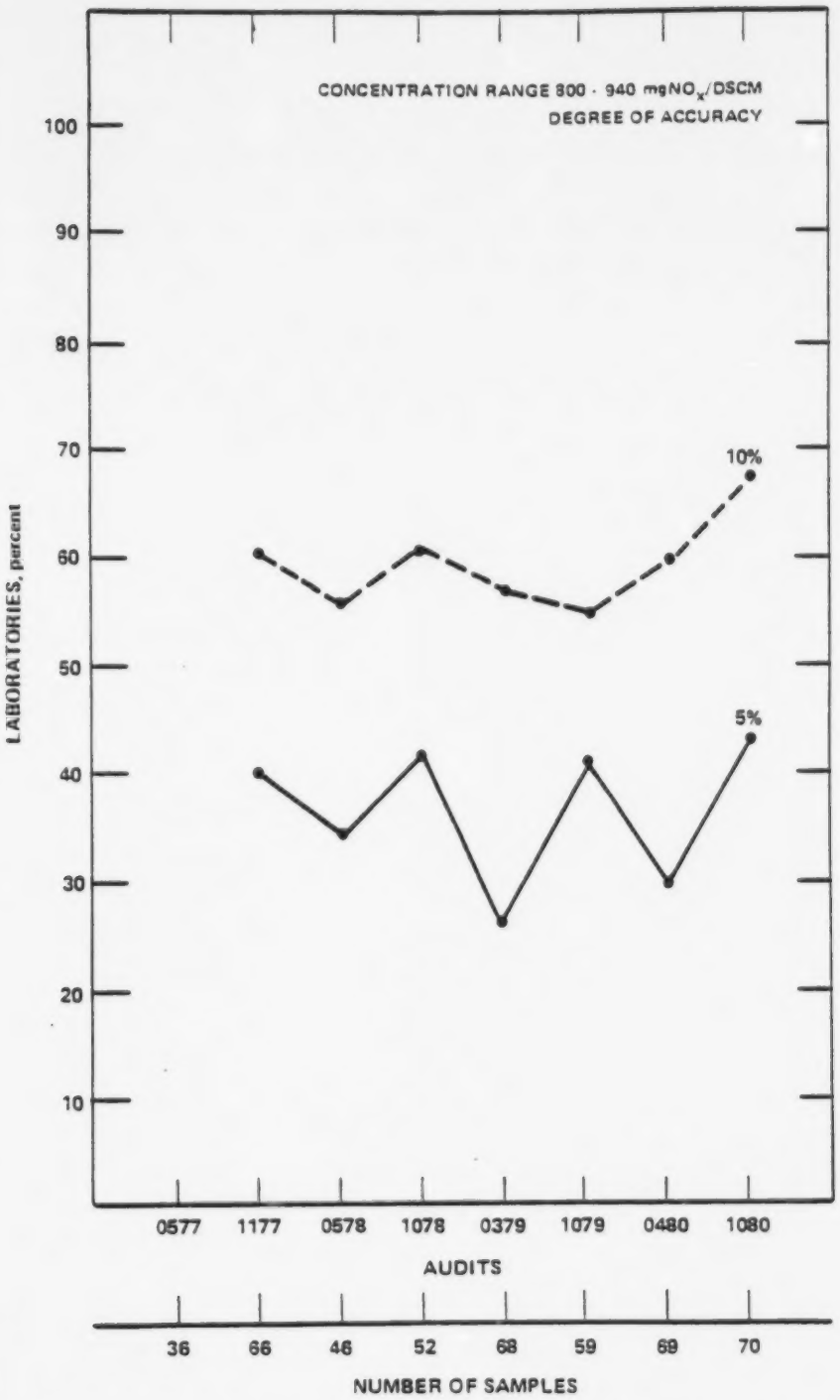

Figure 12. Method 7 previous audit results - high concentration (degree of accuracy 5 and 10 percent).

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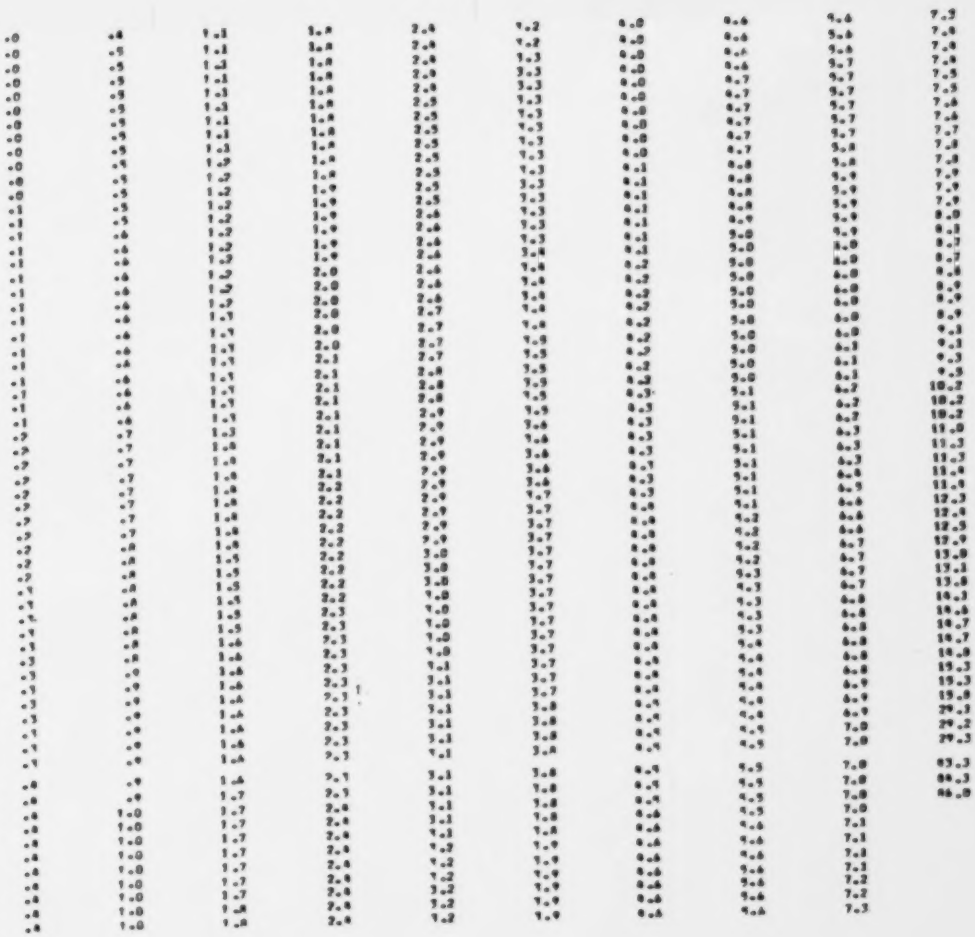
APPENDIX A

INTERLABORATORY STUDY 0280
POLLUTANT: DGM
UNITS: ABSOLUTE PERCENT DIFFERENCE
(DATA IN ASCENDING ORDER)



DGM (0280)

DATA SUMMARY

#SAMP	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN	STDEV
622	.0	.4	1.0	1.7	2.4	3.2	3.9	4.6	5.5	7.0	86.0	4.1	6.5

Skewness = 9.35
Median = 3.2

DATA SUMMARY (ONE PASS)

#SAMP	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN	STDEV
616	.0	.4	1.0	1.7	2.4	3.1	3.8	4.5	5.5	6.9	15.8	3.6	2.9

Skewness = -.16
Median = 3.1

DATA SUMMARY (MULTI-PASS)

#SAMP	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN	STDEV
596	.0	.4	1.0	1.6	2.3	3.1	3.7	4.4	5.1	6.3	10.2	3.2	2.3

Skewness = -.84
Median = 3.1

INTERLABORATORY STUDY 0880
POLLUTANT: DGM
UNITS: ABSOLUTE PERCENT DIFFERENCE
(DATA IN ASCENDING ORDER)

.0	.4	.9	1.5	1.9	2.8	3.9	4.6	5.7	8.7
.0	.4	.9	1.5	1.9	2.8	3.9	4.6	5.8	8.8
.0	.4	.9	1.5	1.9	2.8	3.9	4.6	5.8	8.9
.0	.4	.9	1.5	1.9	2.8	3.9	4.6	5.8	9.1
.0	.5	.9	1.5	2.0	2.8	3.9	4.6	5.8	9.1
.0	.5	.9	1.5	2.0	2.8	3.9	4.7	5.8	9.1
.0	.5	.9	1.5	2.0	2.9	3.9	4.7	5.8	9.3
.0	.5	1.0	1.5	2.0	2.9	3.9	4.7	5.8	9.6
.1	.5	1.0	1.5	2.0	2.9	3.9	4.7	5.9	9.6
.1	.5	1.0	1.5	2.0	2.9	3.9	4.7	5.9	9.8
.1	.5	1.0	1.6	2.0	2.9	3.9	4.7	5.9	9.9
.1	.5	1.0	1.6	2.0	2.9	3.9	4.7	5.9	9.9
.1	.5	1.0	1.6	2.0	2.9	3.9	4.7	5.9	10.0
.1	.5	1.0	1.6	2.0	2.9	3.9	4.8	5.9	10.0
.1	.6	1.0	1.6	2.0	2.9	3.9	4.8	6.0	10.0
.1	.6	1.0	1.6	2.1	2.9	3.9	4.8	6.0	10.1
.1	.6	1.0	1.6	2.1	2.9	3.9	4.8	6.0	10.2
.1	.6	1.0	1.6	2.1	3.0	3.9	4.8	6.0	10.2
.1	.6	1.0	1.6	2.1	3.0	3.9	4.8	6.0	10.6
.1	.6	1.0	1.6	2.1	3.0	3.9	4.9	6.1	11.1
.1	.6	1.0	1.6	2.1	3.0	3.9	4.9	6.1	11.2
.1	.6	1.0	1.6	2.1	3.0	3.9	4.9	6.1	11.6
.1	.6	1.0	1.6	2.1	3.0	3.9	4.9	6.1	11.8
.1	.6	1.0	1.6	2.1	3.0	3.8	4.9	6.1	11.9
.1	.6	1.0	1.7	2.1	3.0	3.8	4.9	6.2	12.1
.1	.6	1.0	1.7	2.1	3.0	3.8	4.9	6.4	12.1
.1	.6	1.0	1.7	2.1	3.0	3.8	4.9	6.4	12.3
.1	.7	1.1	1.7	2.1	3.0	3.8	4.9	6.5	12.4
.2	.7	1.1	1.7	2.2	3.1	3.8	4.9	6.6	12.4
.2	.7	1.1	1.7	2.2	3.1	3.8	4.9	6.7	12.5
.2	.7	1.1	1.7	2.3	3.1	3.8	4.9	6.7	12.6
.2	.7	1.1	1.7	2.3	3.1	3.9	4.9	6.7	12.6
.2	.7	1.1	1.7	2.3	3.1	3.9	5.0	6.7	12.7
.2	.7	1.1	1.7	2.3	3.1	3.9	5.0	6.7	12.7
.2	.7	1.1	1.7	2.3	3.1	3.9	5.0	6.7	13.0
.2	.7	1.1	1.7	2.3	3.1	3.9	5.0	6.7	13.2
.2	.7	1.1	1.7	2.3	3.1	3.9	5.0	6.8	13.2
.2	.7	1.2	1.7	2.3	3.1	4.0	5.0	6.8	13.3
.2	.7	1.2	1.7	2.3	3.1	4.0	5.0	6.8	13.4
.2	.7	1.2	1.7	2.3	3.1	4.0	5.0	6.9	13.5
.2	.7	1.2	1.7	2.3	3.2	4.0	5.0	6.9	13.6
.2	.7	1.2	1.7	2.3	3.2	4.0	5.0	6.9	14.7
.2	.7	1.2	1.7	2.3	3.2	4.0	5.0	6.9	15.3
.2	.7	1.2	1.7	2.3	3.2	4.1	5.0	7.0	16.1
.2	.7	1.2	1.7	2.3	3.2	4.1	5.1	7.0	16.8
.2	.7	1.2	1.8	2.3	3.2	4.1	5.1	7.1	17.5
.2	.7	1.2	1.8	2.4	3.2	4.1	5.1	7.1	18.0
.2	.7	1.2	1.8	2.4	3.2	4.1	5.1	7.2	18.2
.3	.7	1.3	1.8	2.4	3.2	4.2	5.1	7.2	18.2
.3	.8	1.3	1.8	2.5	3.3	4.2	5.1	7.3	18.3
.3	.8	1.3	1.8	2.5	3.3	4.2	5.2	7.3	19.3
.3	.8	1.3	1.8	2.5	3.3	4.2	5.2	7.3	19.3
.3	.8	1.3	1.8	2.5	3.3	4.2	5.3	7.5	19.4
.3	.8	1.3	1.8	2.5	3.3	4.2	5.3	7.5	21.3
.3	.8	1.3	1.8	2.5	3.3	4.3	5.3	7.6	21.4
.3	.8	1.3	1.8	2.5	3.3	4.3	5.3	7.6	21.4
.3	.8	1.3	1.8	2.5	3.3	4.3	5.4	7.7	21.6
.3	.8	1.3	1.8	2.6	3.3	4.3	5.4	7.7	23.8
.3	.8	1.4	1.8	2.6	3.3	4.3	5.4	7.8	23.9
.3	.8	1.4	1.8	2.6	3.4	4.3	5.4	7.8	23.9
.3	.8	1.4	1.8	2.6	3.4	4.3	5.5	7.8	25.8
.4	.8	1.4	1.8	2.6	3.4	4.4	5.5	7.8	27.4
.4	.8	1.4	1.8	2.6	3.4	4.4	5.5	7.9	28.7
.4	.8	1.4	1.8	2.6	3.4	4.4	5.6	7.9	28.7
.4	.8	1.4	1.9	2.7	3.4	4.4	5.6	7.9	29.8
.4	.9	1.4	1.9	2.7	3.4	4.5	5.6	8.0	74.7
.4	.9	1.4	1.9	2.7	3.5	4.5	5.6	8.0	74.9
.4	.9	1.4	1.9	2.7	3.5	4.5	5.6	8.1	79.5
.4	.9	1.4	1.9	2.7	3.5	4.5	5.6	8.2	
.4	.9	1.4	1.9	2.7	3.5	4.5	5.7	8.3	
.4	.9	1.4	1.9	2.7	3.5	4.5	5.7	8.4	
.4	.9	1.5	1.9	2.8	3.5	4.5	5.7	8.4	
.4	.9	1.5	1.9	2.8	3.5	4.6	5.7	8.7	

DGM (0880)

DATA SUMMARY

#SAMP	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN	STDEV
725	.0	.4	.9	1.5	1.9	2.7	3.5	4.5	5.6	8.1	75.5	4.2	6.3

Skewness = 6.71
Median = 2.8

DATA SUMMARY (ONE PASS)

#SAMP	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN	STDEV
717	.0	.4	.9	1.4	1.9	2.7	3.4	4.4	5.5	7.8	23.9	3.7	3.9

Skewness = -,12
Median = 2.7

DATA SUMMARY (MULTI-PASS)

#SAMP	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN	STDEV
676	.0	.4	.8	1.3	1.8	2.3	3.1	3.9	4.9	6.1	10.6	3.0	2.4

Skewness = -.72
Median = 2.4

APPENDIX B: METHOD 6 SO_2 DATA SUMMARY

INTER-LABORATORY STUDY 380

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 2

N	102	RANGE	6081.40	C.I.(UPPER)	537.67
TRUE-VALUE	305.00	VARIANCE	473313.41	C.I.(LOWER)	270.64
MEAN	404.16	STD. DEV.	687.98	SKEWNESS	6.62
MEDIAN	305.00	COEF. VAR.	170.22	ACCURACY	.00

DATA IN ASCENDING ORDER

2.00	297.00	302.90	307.90	317.80
9.70	297.50	302.90	308.10	318.10
30.10	297.60	304.10	308.10	318.20
31.00	298.90	304.20	308.40	318.70
67.30	299.00	304.30	308.50	318.90
228.60	300.20	304.70	308.50	320.40
278.90	300.20	304.90	308.70	321.00
279.50	300.30	305.00	308.90	324.00
280.00	300.80	305.00	309.00	326.00
285.00	300.90	305.00	309.60	329.50
290.20	300.90	305.10	310.30	329.50
290.30	301.00	305.10	310.60	329.90
292.90	301.20	305.50	310.70	352.40
293.50	301.30	305.60	311.20	352.60
293.80	301.40	305.70	311.40	530.00
294.00	301.80	305.70	312.70	2772.90
294.60	302.00	306.60	313.70	3283.40
295.20	302.00	306.80	315.20	6083.40
296.00	302.10	307.00	315.60	
296.80	302.70	307.00	316.10	
296.80	302.70	307.40	316.20	

INTER-LABORATORY STUDY 380

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 2 **** WITH OUTLIERS REMOVED ****

N	99	RANGE	528.00	C.I.(UPPER)	307.04
TRUE-VALUE	305.00	VARIANCE	4528.85	C.I.(LOWER)	280.33
MEAN	293.78	STD. DEV.	67.30	SKEWNESS	-2.72
MEDIAN	305.00	COEF. VAR.	22.91	ACCURACY	.00

DATA IN ASCENDING ORDER

2.00	296.80	302.70	307.00	315.20
9.70	297.00	302.70	307.00	315.60
30.10	297.50	302.90	307.40	316.10
31.00	297.60	302.90	307.90	316.20
67.30	298.90	304.10	308.10	317.80
228.60	299.00	304.20	308.10	318.10
278.90	300.20	304.30	308.40	318.20
279.50	300.20	304.70	308.50	318.70
280.00	300.30	304.90	308.50	318.90
285.00	300.80	305.00	308.70	320.40
290.20	300.90	305.00	308.90	321.00
290.30	300.90	305.00	309.00	324.00
292.90	301.00	305.10	309.60	326.00
293.50	301.20	305.10	310.30	329.50
293.80	301.30	305.50	310.60	329.50
294.00	301.40	305.60	310.70	329.90
294.60	301.80	305.70	311.20	352.40
295.20	302.00	305.70	311.40	352.40
296.00	302.00	306.60	312.70	530.00
296.80	302.10	306.80	313.70	

INTER-LABORATORY STUDY 380

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 3

N	101	RANGE	45981.00	C.I.(UPPER)	4016.58
TRUE-VALUE	2287.80	VARIANCE	26704936.50	C.I.(LOWER)	2000.90
MEAN	3008.74	STD. DEV.	5167.68	SKEWNESS	6.71
MEDIAN	2281.60	COEF. VAR.	171.76	ACCURACY	-.27

DATA IN ASCENDING ORDER

15.30	2241.30	2271.00	2294.10	2326.00
70.10	2242.10	2271.70	2294.20	2327.60
222.90	2243.90	2274.80	2295.30	2338.10
235.30	2254.80	2275.00	2295.90	2342.80
514.80	2255.30	2275.30	2299.30	2348.60
1530.00	2257.00	2278.00	2300.00	2349.20
2160.50	2257.00	2280.00	2300.00	2352.60
2161.00	2260.40	2280.20	2302.40	2352.90
2165.20	2260.80	2281.60	2304.80	2356.30
2189.00	2260.90	2282.00	2305.00	2393.90
2201.20	2261.00	2282.00	2306.00	2459.50
2207.10	2263.80	2282.00	2307.70	2490.70
2208.20	2264.50	2285.00	2309.60	2657.30
2209.50	2265.50	2285.50	2310.70	3089.00
2211.00	2266.20	2287.90	2312.10	20242.00
2211.20	2266.70	2288.00	2314.30	23896.10
2232.80	2267.60	2289.00	2317.60	45996.30
2232.90	2268.30	2290.40	2320.00	
2238.00	2269.20	2291.60	2321.60	
2238.40	2269.60	2292.60	2325.00	
2240.00	2270.50	2293.20	2325.40	

INTER-LABORATORY STUDY 380

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 3 **** WITH OUTLIERS REMOVED ****

N	98	RANGE	3073.70	C.I.(UPPER)	2275.75
TRUE-VALUE	2287.80	VARIANCE	228535.50	C.I.(LOWER)	2086.45
MEAN	2181.10	STD. DEV.	478.05	SKEWNESS	-3.57
MEDIAN	2280.10	COEF. VAR.	21.92	ACCURACY	-.34

DATA IN ASCENDING ORDER

15.30	2240.00	2269.60	2291.60	2320.00
70.10	2241.30	2270.50	2292.60	2321.60
227.90	2242.10	2271.00	2293.20	2325.00
235.30	2243.90	2271.70	2294.10	2325.40
514.80	2254.80	2274.80	2294.20	2326.00
1530.00	2255.30	2275.00	2295.30	2327.60
2160.50	2257.00	2275.30	2295.90	2338.10
2161.00	2257.00	2278.00	2299.30	2342.80
2165.20	2260.40	2280.00	2300.00	2348.60
2189.00	2260.80	2280.20	2300.00	2349.20
2201.20	2260.90	2281.60	2302.40	2352.60
2207.10	2261.00	2282.00	2304.80	2352.90
2208.20	2263.80	2282.00	2305.00	2356.30
2209.50	2264.50	2282.00	2306.00	2393.90
2211.00	2265.50	2285.00	2307.70	2459.50
2211.20	2266.20	2285.50	2309.60	2490.70
2232.80	2266.70	2287.90	2310.70	2657.30
2232.90	2267.60	2288.00	2312.10	3089.00
2238.00	2268.30	2289.00	2314.30	
2238.40	2269.20	2290.40	2317.60	

INTER-LABORATORY STUDY 380

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 5

N	102	RANGE	34485.70	C.I.(UPPER)	2993.36
TRUE-VALUE	1715.90	VARIANCE	14800565.37	C.I.(LOWER)	1500.14
MEAN	2246.75	STD. DEV.	3847.15	SKEWNESS	6.78
MEDIAN	1704.45	COEF. VAR.	171.23	ACCURACY	-.67

DATA IN ASCENDING ORDER

11.50	1672.60	1699.10	1716.40	1741.30
52.00	1681.60	1699.70	1717.90	1742.00
169.60	1682.90	1700.00	1718.00	1744.80
173.60	1683.00	1700.30	1720.00	1754.10
378.50	1684.60	1701.00	1720.30	1756.60
1160.00	1685.10	1701.70	1720.70	1757.10
1608.10	1685.70	1702.80	1721.20	1764.60
1616.30	1686.60	1703.20	1721.30	1772.30
1618.10	1686.70	1704.40	1721.70	1806.70
1641.80	1688.00	1704.50	1721.80	1837.90
1648.90	1689.20	1705.60	1722.30	1862.00
1652.40	1691.50	1706.00	1723.40	1877.90
1654.60	1691.70	1706.90	1725.70	1948.70
1655.90	1691.80	1707.20	1726.10	2043.00
1656.30	1692.80	1711.10	1728.00	2239.90
1660.60	1694.40	1712.00	1733.30	14765.60
1661.30	1694.90	1714.00	1733.40	18011.30
1661.70	1695.30	1714.00	1735.00	34497.20
1669.00	1696.00	1715.30	1735.30	
1670.10	1696.80	1715.90	1740.00	
1671.30	1699.10	1716.20	1740.40	

INTER-LABORATORY STUDY 380

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 5 **** WITH OUTLIERS REMOVED ****

N	99	RANGE	2228.40	C.I.(UPPER)	1705.68
TRUE-VALUE	1715.90	VARIANCE	127649.67	C.I.(LOWER)	1564.92
MEAN	1635.30	STD. DEV.	357.28	SKEWNESS	-3.59
MEDIAN	1703.20	COEF. VAR.	21.85	ACCURACY	-.74

DATA IN ASCENDING ORDER

11.50	1671.30	1696.80	1715.30	1735.00
52.00	1672.60	1699.10	1715.90	1735.30
169.60	1681.60	1699.10	1716.20	1740.00
173.60	1682.90	1699.70	1716.40	1740.40
378.50	1683.00	1700.00	1717.90	1741.30
1160.00	1684.60	1700.30	1718.00	1742.00
1608.10	1685.10	1701.00	1720.00	1744.80
1616.30	1685.70	1701.70	1720.30	1754.10
1618.10	1686.60	1702.80	1720.70	1756.60
1641.80	1686.70	1703.20	1721.20	1757.10
1648.90	1688.00	1704.40	1721.30	1764.60
1652.40	1689.20	1704.50	1721.70	1772.30
1654.60	1691.50	1705.60	1721.80	1806.70
1655.90	1691.70	1706.00	1722.30	1837.90
1656.30	1691.80	1706.90	1723.40	1862.00
1660.60	1692.80	1707.20	1725.70	1877.90
1661.30	1694.40	1711.10	1726.10	1948.70
1661.70	1694.90	1712.00	1728.00	2043.00
1669.00	1695.30	1714.00	1733.30	2239.90
1670.10	1696.00	1714.00	1733.40	

INTER-LABORATORY STUDY 380

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 6

N	102	RANGE	26698.40	C.I.(UPPER)	2325.46
TRUE-VALUE	1334.60	VARIANCE	8923316.25	C.I.(LOWER)	1166.02
MEAN	1745.74	STD. DEV.	2987.19	SKEWNESS	6.75
MEDIAN	1322.95	COEF. VAR.	171.11	ACCURACY	-.87

DATA IN ASCENDING ORDER

9.10	1300.00	1315.40	1331.40	1357.00
40.40	1300.00	1316.20	1331.70	1358.90
132.20	1300.00	1316.30	1333.10	1362.40
136.20	1300.00	1316.40	1333.30	1368.80
292.70	1300.00	1316.70	1333.50	1374.90
1229.40	1300.50	1317.40	1334.60	1390.30
1258.30	1304.10	1319.00	1335.40	1390.50
1260.00	1304.50	1321.20	1335.70	1408.00
1262.90	1304.80	1322.40	1336.00	1408.70
1269.00	1306.00	1323.50	1336.70	1423.60
1281.50	1307.20	1325.10	1337.10	1433.50
1281.70	1309.00	1325.90	1337.10	1451.80
1284.90	1311.60	1326.10	1338.40	1457.80
1286.00	1312.10	1326.20	1338.90	1492.00
1286.00	1314.00	1326.70	1343.30	1585.60
1287.10	1314.30	1327.00	1344.60	11576.70
1288.80	1314.60	1327.20	1344.80	14069.60
1290.50	1315.40	1327.50	1350.00	26707.50
1294.00	1315.40	1328.90	1350.80	
1294.30	1315.40	1330.00	1353.50	
1297.00	1315.40	1330.20	1356.60	

INTER-LABORATORY STUDY 380

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 6 **** WITH OUTLIERS REMOVED ****

N	99	RANGE	1576.50	C.I.(UPPER)	1323.27
TRUE-VALUE	1334.60	VARIANCE	73639.04	C.I.(LOWER)	1216.36
MEAN	1269.82	STD. DEV.	271.37	SKEWNESS	-3.86
MEDIAN	1321.20	COEF. VAR.	21.37	ACCURACY	-1.00

DATA IN ASCENDING ORDER

9.10	1297.00	1315.40	1328.90	1350.00
40.40	1300.00	1315.40	1330.00	1350.80
132.20	1300.00	1315.40	1330.20	1353.50
136.20	1300.00	1316.20	1331.40	1356.60
292.70	1300.00	1316.30	1331.70	1357.00
1229.40	1300.00	1316.60	1333.10	1358.90
1258.30	1300.50	1316.70	1333.30	1362.40
1260.00	1304.10	1317.40	1333.50	1368.80
1262.90	1304.50	1319.00	1334.60	1374.90
1269.00	1304.80	1321.20	1335.40	1390.30
1281.50	1306.00	1322.40	1335.70	1390.50
1281.70	1307.20	1323.50	1336.00	1408.00
1284.90	1309.00	1325.10	1336.70	1408.70
1286.00	1311.60	1325.90	1337.10	1423.60
1286.00	1312.10	1326.10	1337.10	1433.50
1287.10	1314.00	1326.20	1338.40	1451.80
1288.80	1314.30	1326.70	1338.90	1457.80
1290.50	1314.60	1327.00	1343.30	1492.00
1294.00	1315.40	1327.20	1344.60	1585.60
1294.30	1315.40	1327.50	1344.80	

INTER-LABORATORY STUDY 380

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 8

N	102	RANGE	15092.00	C.I.(UPPER)	1331.15
TRUE-VALUE	762.60	VARIANCE	2879014.87	C.I.(LOWER)	672.57
MEAN	1001.86	STD. DEV.	1696.77	SKEWNESS	6.68
MEDIAN	754.55	COEF. VAR.	169.36	ACCURACY	-1.06

DATA IN ASCENDING ORDER

5.20	743.20	752.00	762.80	778.50
23.20	744.00	752.70	763.40	779.00
75.00	744.30	753.00	763.90	779.30
77.40	744.80	753.30	764.10	779.50
166.80	745.00	753.70	764.50	780.40
709.80	745.50	753.80	764.80	785.90
713.80	745.60	753.90	765.00	787.50
717.50	746.50	754.00	765.30	790.10
718.80	746.80	754.50	766.40	802.60
724.50	747.30	754.60	766.40	819.00
726.60	747.40	755.00	766.60	822.60
727.70	747.40	755.20	767.30	823.60
729.00	747.60	756.70	768.90	824.80
730.20	749.20	756.90	769.50	912.10
733.00	749.80	757.70	769.50	1366.00
735.30	750.00	758.00	770.70	6654.90
736.80	750.40	758.80	774.80	8081.70
737.00	751.10	759.80	776.00	15097.20
737.70	751.20	761.50	776.30	
738.00	751.30	762.60	777.00	
740.50	751.90	762.70	777.60	

INTER-LABORATORY STUDY 380

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 8 **** WITH OUTLIERS REMOVED ****

N	99	RANGE	1360.80	C.I.(UPPER)	763.87
TRUE-VALUE	762.60	VARIANCE	28069.38	C.I.(LOWER)	697.87
MEAN	730.87	STD. DEV.	167.54	SKEWNESS	-2.60
MEDIAN	754.00	COEF. VAR.	22.92	ACCURACY	-1.13

DATA IN ASCENDING ORDER

5.20	740.50	751.30	761.50	776.00
23.20	743.20	751.90	762.60	776.30
75.00	744.00	752.00	762.70	777.00
77.40	744.30	752.70	762.80	777.60
166.80	744.80	753.00	763.40	778.50
709.80	745.00	753.30	763.90	779.00
713.80	745.50	753.70	764.10	779.30
717.50	745.60	753.80	764.50	779.50
718.80	746.50	753.90	764.80	780.40
724.50	746.80	754.00	765.00	785.90
726.60	747.30	754.50	765.30	787.50
727.70	747.40	754.60	766.40	790.10
729.00	747.40	755.00	766.40	802.60
730.20	747.60	755.20	766.60	819.00
733.00	749.20	756.70	767.30	822.60
735.30	749.80	756.90	768.90	823.60
736.80	750.00	757.70	769.50	824.80
737.00	750.40	758.00	769.50	912.10
737.70	751.10	758.80	770.70	1366.00
738.00	751.20	759.80	774.80	

INTER-LABORATORY STUDY 980

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 1

N	100	RANGE	1234.00	C.I.(UPPER)	1139.94
TRUE-VALUE	1143.90	VARIANCE	26075.44	C.I.(LOWER)	1076.70
MEAN	1108.32	STD. DEV.	161.32	SKEWNESS	-3.35
MEDIAN	1137.40	COEF. VAR.	14.56	ACCURACY	-.57

DATA IN ASCENDING ORDER

215.90	1112.00	1132.50	1148.00	1163.70
376.00	1113.00	1135.60	1148.70	1164.80
570.00	1113.00	1135.70	1150.40	1164.90
602.50	1113.20	1136.00	1150.80	1168.30
652.60	1113.40	1136.00	1151.10	1170.30
944.40	1114.90	1136.30	1151.20	1177.50
956.00	1116.10	1137.00	1151.60	1178.00
1001.90	1117.00	1137.10	1151.60	1189.70
1030.00	1117.00	1137.70	1152.00	1193.70
1069.30	1118.60	1139.90	1152.30	1214.00
1075.30	1120.00	1141.10	1153.10	1220.70
1078.20	1122.60	1142.30	1154.70	1227.00
1079.90	1124.90	1143.90	1155.40	1259.00
1080.20	1126.50	1145.10	1157.80	1311.10
1085.10	1127.00	1145.20	1159.00	1398.00
1087.60	1128.70	1145.30	1159.50	1449.90
1093.30	1128.70	1145.50	1159.50	
1095.60	1129.20	1146.20	1160.70	
1103.70	1130.20	1147.00	1161.00	
1108.50	1132.30	1147.60	1162.30	
1109.60	1132.50	1147.60	1163.50	

INTER-LABORATORY STUDY 980

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 1 **** WITH OUTLIERS REMOVED ****

N	96	RANGE	797.30	C.I.(UPPER)	1152.33
TRUE-VALUE	1143.90	VARIANCE	6568.26	C.I.(LOWER)	1119.91
MEAN	1136.12	STD. DEV.	81.04	SKEWNESS	-1.42
MEDIAN	1140.50	COEF. VAR.	7.13	ACCURACY	-.30

DATA IN ASCENDING ORDER

652.60	1113.20	1135.70	1148.70	1163.70
944.40	1113.40	1136.00	1150.40	1164.80
956.00	1114.90	1136.00	1150.80	1164.90
1001.90	1116.10	1136.30	1151.10	1168.30
1030.00	1117.00	1137.00	1151.20	1170.30
1069.30	1117.00	1137.10	1151.60	1177.50
1075.30	1118.60	1137.70	1151.60	1178.00
1078.20	1120.00	1139.90	1152.00	1189.70
1079.90	1122.60	1141.10	1152.30	1193.70
1080.20	1124.90	1142.30	1153.10	1214.00
1085.10	1126.50	1143.90	1154.70	1220.70
1087.60	1127.00	1145.10	1155.40	1227.00
1093.30	1128.70	1145.20	1157.80	1259.00
1095.60	1128.70	1145.30	1159.00	1311.10
1103.70	1129.20	1145.50	1159.50	1398.00
1108.50	1130.20	1146.20	1159.50	1449.90
1109.60	1132.30	1147.00	1160.70	
1112.00	1132.50	1147.60	1161.00	
1113.00	1132.50	1147.60	1162.30	
1113.00	1135.60	1148.00	1163.50	

INTER-LABORATORY STUDY 980

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 2

N	99	RANGE	2052.60	C.I.(UPPER)	1885.31
TRUE-VALUE	1906.50	VARIANCE	72737.71	C.I.(LOWER)	1779.06
MEAN	1832.18	STD. DEV.	269.70	SKEWNESS	-3.78
MEDIAN	1889.90	COEF. VAR.	14.72	ACCURACY	-.87

DATA IN ASCENDING ORDER

351.00	1834.70	1877.10	1900.30	1926.20
357.90	1839.60	1879.00	1900.40	1927.10
960.00	1840.70	1881.40	1900.40	1930.70
1083.10	1842.50	1881.90	1903.40	1932.50
1395.60	1846.00	1882.20	1904.00	1934.00
1580.60	1847.40	1883.70	1906.50	1934.80
1606.40	1848.00	1886.30	1907.00	1937.90
1625.60	1849.00	1888.10	1909.30	1938.60
1655.30	1851.40	1888.30	1910.40	1940.00
1737.70	1855.00	1889.90	1910.40	1940.20
1750.20	1857.00	1891.20	1910.90	1948.10
1754.00	1860.60	1892.30	1913.30	1952.10
1761.60	1863.00	1895.00	1913.80	1982.80
1762.50	1867.10	1895.30	1918.00	2000.70
1775.20	1868.40	1895.30	1918.00	2018.00
1792.00	1869.60	1895.50	1919.30	2037.10
1798.40	1870.30	1898.00	1921.30	2098.20
1811.00	1875.90	1899.90	1922.40	2223.00
1815.40	1876.00	1900.00	1924.20	2403.60
1829.30	1876.40	1900.00	1925.60	

INTER-LABORATORY STUDY 980

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 2 **** WITH OUTLIERS REMOVED ****

N	95	RANGE	1008.00	C.I.(UPPER)	1903.26
TRUE-VALUE	1906.50	VARIANCE	12963.23	C.I.(LOWER)	1857.47
MEAN	1880.36	STD. DEV.	113.86	SKEWNESS	.02
MEDIAN	1892.30	COEF. VAR.	6.06	ACCURACY	-.74

DATA IN ASCENDING ORDER

1395.60	1846.00	1882.20	1904.00	1934.00
1580.60	1847.40	1883.70	1906.50	1934.80
1606.40	1848.00	1886.30	1907.00	1937.90
1625.60	1849.00	1888.10	1909.30	1938.60
1655.30	1851.40	1888.30	1910.40	1940.00
1737.70	1855.00	1889.90	1910.40	1940.20
1750.20	1857.00	1891.20	1910.90	1948.10
1754.00	1860.60	1892.30	1913.30	1952.10
1761.60	1863.00	1895.00	1913.80	1982.80
1762.50	1867.10	1895.30	1918.00	2000.70
1775.20	1868.40	1895.30	1918.00	2018.00
1792.00	1869.60	1895.50	1919.30	2037.10
1798.40	1870.30	1898.00	1921.30	2098.20
1811.00	1875.90	1899.90	1922.40	2223.00
1815.40	1876.00	1900.00	1924.20	2403.60
1829.30	1876.40	1900.00	1925.60	
1834.70	1877.10	1900.30	1926.20	
1839.60	1879.00	1900.40	1927.10	
1840.70	1881.40	1900.40	1930.70	
1842.50	1881.90	1903.40	1932.50	

INTER-LABORATORY STUDY 980

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 4

N	100	RANGE	840.50	C.I.(UPPER)	762.05
TRUE-VALUE	762.60	VARIANCE	8424.88	C.I.(LOWER)	726.07
MEAN	744.06	STD. DEV.	91.79	SKEWNESS	-3.47
MEDIAN	757.80	COEF. VAR.	12.34	ACCURACY	-.63

DATA IN ASCENDING ORDER

152.10	736.50	755.00	765.10	778.00
380.00	738.00	755.00	765.60	780.70
433.10	738.90	755.30	766.20	782.00
583.70	739.00	755.80	767.20	782.70
587.20	739.00	756.90	768.20	784.10
666.00	739.30	757.20	768.50	784.70
672.10	743.00	757.60	768.50	787.00
682.30	743.10	757.60	768.70	789.90
682.90	743.60	758.00	770.00	791.10
698.00	744.40	758.20	770.20	820.10
701.50	744.40	758.30	770.20	832.40
705.00	745.90	758.40	770.60	832.80
708.20	747.40	760.50	770.90	836.20
711.40	747.40	760.90	771.40	855.70
716.20	748.70	761.00	771.80	932.00
724.10	752.30	761.00	771.80	992.60
725.90	752.30	761.00	773.30	
726.20	753.10	762.30	773.80	
732.10	754.00	762.60	777.10	
733.00	754.50	764.80	777.60	
736.00	755.00	764.90	777.60	

INTER-LABORATORY STUDY 980

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 4 **** WITH OUTLIERS REMOVED ****

N	97	RANGE	408.90	C.I.(UPPER)	767.02
TRUE-VALUE	762.60	VARIANCE	2477.83	C.I.(LOWER)	747.21
MEAN	757.12	STD. DEV.	49.78	SKEWNESS	.66
MEDIAN	758.20	COEF. VAR.	6.57	ACCURACY	-.58

DATA IN ASCENDING ORDER

583.70	738.90	755.00	765.10	777.60
587.20	739.00	755.30	765.60	778.00
666.00	739.00	755.80	766.20	780.70
672.10	739.30	756.90	767.20	782.00
682.30	743.00	757.20	768.20	782.70
682.90	743.10	757.60	768.50	784.10
698.00	743.60	757.60	768.50	784.70
701.50	744.40	758.00	768.70	787.00
705.00	744.40	758.20	770.00	789.90
708.20	745.90	758.30	770.20	791.10
711.40	747.40	758.40	770.20	820.10
716.20	747.40	760.50	770.60	832.40
724.10	748.70	760.90	770.90	832.80
725.90	752.30	761.00	771.40	836.20
726.20	752.30	761.00	771.80	855.70
732.10	753.10	761.00	771.80	932.00
733.00	754.00	762.30	773.30	992.60
736.00	754.50	762.60	773.80	
736.50	755.00	764.80	777.10	
738.00	755.00	764.90	777.60	

INTER-LABORATORY STUDY 980

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 5

N	99	RANGE	2473.50	C.I.(UPPER)	2271.81
TRUE-VALUE	2287.80	VARIANCE	66954.33	C.I.(LOWER)	2169.87
MEAN	2220.84	STD. DEV.	258.76	SKEWNESS	-4.22
MEDIAN	2274.40	COEF. VAR.	11.65	ACCURACY	-.59

DATA IN ASCENDING ORDER

436.10	2201.70	2260.70	2284.70	2310.40
1150.00	2208.00	2263.00	2285.60	2312.70
1354.40	2209.90	2266.20	2285.90	2313.00
1895.40	2216.90	2268.80	2286.50	2313.80
1929.40	2219.30	2270.80	2286.90	2316.20
1991.50	2222.30	2271.00	2287.00	2320.20
2010.00	2224.00	2272.00	2287.00	2323.70
2033.70	2236.00	2272.60	2287.80	2328.00
2057.00	2238.30	2274.00	2288.00	2328.40
2109.00	2239.90	2274.40	2290.50	2331.00
2118.50	2241.40	2275.20	2294.10	2340.70
2122.00	2244.80	2276.20	2295.50	2340.80
2128.00	2245.00	2276.20	2297.00	2351.90
2133.10	2245.90	2276.50	2297.80	2367.00
2141.00	2247.00	2277.40	2300.10	2379.40
2150.00	2250.10	2280.50	2303.10	2433.20
2150.60	2253.60	2281.40	2303.10	2488.00
2155.00	2254.10	2281.60	2305.60	2536.00
2182.80	2255.30	2282.70	2307.20	2909.60
2195.70	2257.00	2283.00	2307.90	

INTER-LABORATORY STUDY 980

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 5 **** WITH OUTLIERS REMOVED ****

N	96	RANGE	1014.20	C.I.(UPPER)	2283.32
TRUE-VALUE	2287.80	VARIANCE	14047.37	C.I.(LOWER)	2235.90
MEAN	2259.61	STD. DEV.	118.52	SKEWNESS	1.01
MEDIAN	2275.70	COEF. VAR.	5.25	ACCURACY	-.33

DATA IN ASCENDING ORDER

1895.40	2216.90	2268.80	2286.50	2313.80
1929.40	2219.30	2270.80	2286.90	2316.20
1991.50	2222.30	2271.00	2287.00	2320.20
2010.00	2224.00	2272.00	2287.00	2323.70
2033.70	2236.00	2272.60	2287.80	2328.00
2057.00	2238.30	2274.00	2288.00	2328.40
2109.00	2239.90	2274.40	2290.50	2331.00
2118.50	2241.40	2275.20	2294.10	2340.70
2122.00	2244.80	2276.20	2295.50	2340.80
2128.00	2245.00	2276.20	2297.00	2351.90
2133.10	2245.90	2276.50	2297.80	2367.00
2141.00	2247.00	2277.40	2300.10	2379.40
2150.00	2250.10	2280.50	2303.10	2433.20
2150.60	2253.60	2281.40	2303.10	2488.00
2155.00	2254.10	2281.60	2305.60	2536.00
2182.80	2255.30	2282.70	2307.20	2909.60
2195.70	2257.00	2283.00	2307.90	
2201.70	2260.70	2284.70	2310.40	
2208.00	2263.00	2285.60	2312.70	
2209.90	2266.20	2285.90	2313.00	

INTER-LABORATORY STUDY 980

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 8

N	101	RANGE	428.70	C.I.(UPPER)	382.21
TRUE-VALUE	381.30	VARIANCE	2583.43	C.I.(LOWER)	362.38
MEAN	372.29	STD. DEV.	50.83	SKEWNESS	-2.61
MEDIAN	380.50	COEF. VAR.	13.65	ACCURACY	-.21

DATA IN ASCENDING ORDER

72.40	368.00	376.10	384.40	394.10
190.00	369.60	376.40	384.40	394.30
213.50	369.70	376.40	385.80	396.60
272.40	369.70	377.50	386.00	396.80
282.20	369.90	377.50	386.20	397.20
284.00	369.90	377.50	386.70	397.70
311.10	370.00	378.80	387.10	400.00
314.30	370.30	379.40	387.40	406.60
323.60	370.50	380.50	388.20	409.60
329.80	370.70	380.60	388.60	414.00
334.70	370.70	381.00	388.60	419.80
336.40	371.10	381.30	388.90	427.50
338.00	372.30	381.30	388.90	432.00
343.00	372.40	382.50	388.90	440.80
351.40	372.80	383.00	389.60	449.90
355.00	373.00	383.80	389.70	495.00
361.50	373.70	383.90	389.70	501.10
365.40	373.70	384.00	391.20	
365.40	373.70	384.00	391.20	
365.70	373.80	384.00	391.80	
367.00	376.00	384.30	393.40	

INTER-LABORATORY STUDY 980

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 8 **** WITH OUTLIERS REMOVED ****

N	98	RANGE	228.70	C.I.(UPPER)	385.37
TRUE-VALUE	381.30	VARIANCE	1090.37	C.I.(LOWER)	372.30
MEAN	378.84	STD. DEV.	33.02	SKEWNESS	.09
MEDIAN	380.80	COEF. VAR.	8.72	ACCURACY	-.13

DATA IN ASCENDING ORDER

272.40	369.70	376.40	384.40	393.40
282.20	369.70	376.40	384.40	394.10
284.00	369.90	377.50	385.80	394.30
311.10	369.90	377.50	386.00	396.60
314.30	370.00	377.50	386.20	396.80
323.60	370.30	378.80	386.70	397.20
329.80	370.50	379.40	387.10	397.70
334.70	370.70	380.50	387.40	400.00
336.40	370.70	380.60	388.20	406.60
338.00	371.10	381.00	388.60	409.60
343.00	372.30	381.30	388.60	414.00
351.40	372.40	381.30	388.90	419.80
355.00	372.80	382.50	388.90	427.50
361.50	373.00	383.00	388.90	432.00
365.40	373.70	383.80	389.60	440.80
365.40	373.70	383.90	389.70	449.90
365.70	373.70	384.00	389.70	495.00
367.00	373.80	384.00	391.20	501.10
368.00	376.00	384.00	391.20	
369.60	376.10	384.30	391.80	

APPENDIX C: METHOD 7 NO_x DATA SUMMARY

INTER-LABORATORY STUDY 480

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 1

N	69	RANGE	3698.30	C.I.(UPPER)	842.40
TRUE-VALUE	697.34	VARIANCE	190767.81	C.I.(LOWER)	636.31
MEAN	739.35	STD. DEV.	436.70	SKEWNESS	4.47
MEDIAN	704.90	COEF. VAR.	59.07	ACCURACY	1.08

DATA IN ASCENDING ORDER

8.80	670.60	692.10	730.60	760.00
13.10	671.10	694.70	730.90	764.00
172.90	679.60	697.00	731.60	769.00
210.40	681.30	697.30	731.80	788.80
245.20	681.60	700.00	732.30	792.90
343.50	682.00	702.50	739.50	803.50
365.20	683.10	704.90	739.60	816.00
475.00	683.50	711.00	744.00	954.40
511.80	685.80	716.00	744.50	1118.50
600.00	687.50	717.50	745.10	1350.00
622.60	688.90	722.50	746.00	1479.40
623.50	690.00	723.40	750.80	1542.50
634.00	690.20	724.80	756.90	3697.10
670.00	692.00	728.20	760.00	

INTER-LABORATORY STUDY 480

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 1 **** WITH OUTLIERS REMOVED ****

N	68	RANGE	1533.70	C.I.(UPPER)	754.59
TRUE-VALUE	697.34	VARIANCE	61062.93	C.I.(LOWER)	627.12
MEAN	695.86	STD. DEV.	247.11	SKEWNESS	.37
MEDIAN	703.70	COEF. VAR.	35.51	ACCURACY	.91

DATA IN ASCENDING ORDER

8.80	670.60	692.10	730.60	760.00
13.10	671.10	694.70	730.90	764.00
172.90	679.60	697.00	731.60	769.00
210.40	681.30	697.30	731.80	788.80
245.20	681.60	700.00	732.30	792.90
343.50	682.00	702.50	739.50	803.50
365.20	683.10	704.90	739.60	816.00
475.00	683.50	711.00	744.00	954.40
511.80	685.80	716.00	744.50	1118.50
600.00	687.50	717.50	745.10	1350.00
622.60	688.90	722.50	746.00	1479.40
623.50	690.00	723.40	750.80	1542.50
634.00	690.20	724.80	756.90	
670.00	692.00	728.20	760.00	

INTER-LABORATORY STUDY 48C

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 2

N	71	RANGE	923.50	C.I.(UPPER)	353.44
TRUE-VALUE	298.73	VARIANCE	20287.61	C.I.(LOWER)	287.18
MEAN	320.31	STD. DEV.	142.43	SKEWNESS	3.12
MEDIAN	303.30	COEF. VAR.	44.47	ACCURACY	1.53

DATA IN ASCENDING ORDER

70.70	284.50	300.60	310.00	334.80
104.40	286.00	301.60	310.40	335.10
116.30	290.50	301.70	311.60	343.80
144.40	292.10	302.40	313.00	345.40
147.10	294.00	303.00	313.70	355.40
159.70	294.30	303.30	314.00	396.30
244.40	295.20	303.40	314.00	475.00
256.00	298.10	304.00	314.30	615.40
264.00	298.10	305.00	315.00	626.30
264.90	298.80	305.50	318.00	998.70
265.10	298.90	306.00	319.60	1004.20
270.20	299.70	306.00	323.00	
271.60	300.00	307.60	330.00	
278.50	300.30	308.90	332.90	
282.80	300.40	309.60	333.00	

INTER-LABORATORY STUDY 48C

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 3 **** WITH OUTLIERS REMOVED ****

N	69	RANGE	555.60	C.I.(UPPER)	320.08
TRUE-VALUE	298.73	VARIANCE	6842.85	C.I.(LOWER)	281.05
MEAN	300.57	STD. DEV.	82.72	SKEWNESS	.92
MEDIAN	303.00	COEF. VAR.	27.52	ACCURACY	1.43

DATA IN ASCENDING ORDER

70.70	282.80	300.30	307.60	323.00
104.40	284.50	300.40	308.90	330.00
116.30	286.00	300.60	309.60	332.90
144.40	290.50	301.60	310.00	333.00
147.10	292.10	301.70	310.40	334.80
159.70	294.00	302.40	311.60	335.10
244.40	294.30	303.00	313.00	343.80
256.00	295.20	303.30	313.70	345.40
264.00	298.10	303.40	314.00	355.40
264.90	298.10	304.00	314.00	396.30
265.10	298.80	305.00	314.30	475.00
270.20	298.90	305.50	315.00	615.40
271.60	299.70	306.00	318.00	626.30
278.50	300.00	306.00	319.00	

INTER-LABORATORY STUDY 480

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 7

N	69	RANGE	4276.50	C.I.(UPPER)	1135.41
TRUE-VALUE	896.54	VARIANCE	307509.23	C.I.(LOWER)	873.71
MEAN	1004.56	STD. DEV.	554.54	SKEWNESS	3.62
MEDIAN	912.50	COEF. VAR.	55.20	ACCURACY	1.78

DATA IN ASCENDING ORDER

150.60	877.50	904.60	937.20	1009.60
153.30	879.50	908.00	945.00	1016.50
162.50	880.50	910.00	950.00	1029.00
304.10	881.00	910.30	959.90	1042.00
425.00	883.50	912.40	961.50	1083.00
454.00	888.20	912.50	962.90	1223.30
700.00	890.00	912.50	965.50	1564.90
734.40	890.30	916.50	976.00	1775.00
781.90	892.20	922.80	978.00	1875.20
806.70	894.00	925.10	983.00	1965.60
810.40	895.00	925.50	995.10	2053.50
855.20	900.90	930.00	996.80	2228.20
870.60	901.60	935.00	1000.80	4427.40
875.30	902.00	935.00	1008.80	

INTER-LABORATORY STUDY 480

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 7 **** WITH OUTLIERS REMOVED ****

N	68	RANGE	2077.30	C.I.(UPPER)	1041.45
TRUE-VALUE	896.54	VARIANCE	134664.15	C.I.(LOWER)	867.00
MEAN	954.22	STD. DEV.	366.97	SKEWNESS	1.16
MEDIAN	912.50	COEF. VAR.	38.46	ACCURACY	1.78

DATA IN ASCENDING ORDER

150.60	877.50	904.60	937.20	1009.60
153.30	879.50	908.00	945.00	1016.50
162.50	880.50	910.00	950.00	1029.00
304.10	881.00	910.30	959.90	1042.00
425.00	883.50	912.40	961.50	1083.00
454.00	888.20	912.50	962.90	1223.30
700.00	890.00	912.50	965.50	1564.90
734.40	890.30	916.50	976.00	1775.00
781.90	892.20	922.80	978.00	1875.20
806.70	894.00	925.10	983.00	1965.60
810.40	895.00	925.50	995.10	2053.50
855.20	900.90	930.00	996.80	2228.20
870.60	901.60	935.00	1000.80	
875.30	902.00	935.00	1008.80	

INTER-LABORATORY STUDY 480

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 8

N	69	RANGE	1057.00	C.I.(UPPER)	211.45
TRUE-VALUE	149.37	VARIANCE	18941.54	C.I.(LOWER)	146.30
MEAN	178.87	STD. DEV.	137.63	SKEWNESS	4.71
MEDIAN	154.30	COEF. VAR.	76.90	ACCURACY	3.43

DATA IN SCENDING ORDER

16.80	144.30	150.40	156.00	168.40
50.80	144.90	151.00	157.00	168.50
51.50	145.10	151.70	157.00	170.00
75.30	145.40	152.50	157.00	170.40
79.30	145.70	153.30	157.20	170.50
142.90	146.00	153.50	157.20	193.00
126.40	146.50	154.50	159.70	300.00
128.40	147.00	154.60	160.00	309.80
131.70	147.50	155.00	160.30	320.70
135.00	147.90	155.00	161.10	324.10
137.60	147.90	155.10	161.70	365.10
140.00	149.00	156.00	163.20	681.40
140.10	149.70	156.00	166.10	1073.80
143.60	149.90	156.30	168.20	

INTER-LABORATORY STUDY 480

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 8 **** WITH OUTLIERS REMOVED ****

N	67	RANGE	348.30	C.I.(UPPER)	171.49
TRUE-VALUE	149.37	VARIANCE	3117.21	C.I.(LOWER)	144.75
MEAN	158.12	STD. DEV.	55.83	SKEWNESS	1.51
MEDIAN	153.50	COEF. VAR.	35.31	ACCURACY	2.76

DATA IN ASCENDING ORDER

16.80	144.30	150.40	156.00	168.40
50.80	144.90	151.00	157.00	168.50
51.50	145.10	151.70	157.00	170.00
75.30	145.40	152.50	157.00	170.40
79.30	145.70	153.30	157.20	170.50
142.90	146.00	153.50	157.20	193.00
126.40	146.50	154.50	159.70	300.00
128.40	147.00	154.60	160.00	309.80
131.70	147.50	155.00	160.30	320.70
135.00	147.90	155.00	161.10	324.10
137.60	147.90	155.10	161.70	365.10
140.00	149.00	156.00	163.20	
140.10	149.70	156.00	166.10	
143.60	149.90	156.30	168.20	

INTER-LABORATORY STUDY 480

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 9

N	70	RANGE	1935.30	C.I.(UPPER)	622.77
TRUE-VALUE	498.04	VARIANCE	85536.70	C.I.(LOWER)	485.74
MEAN	554.25	STD. DEV.	292.47	SKEWNESS	3.03
MEDIAN	509.20	COEF. VAR.	52.77	ACCURACY	2.04

DATA IN ASCENDING ORDER

15.50	483.00	499.20	525.30	575.00
83.20	485.40	500.00	527.00	594.00
129.60	488.30	502.90	528.60	598.00
176.80	488.60	505.70	529.00	647.90
253.40	490.00	505.90	530.00	950.00
299.10	490.50	510.50	530.60	988.10
415.60	492.30	511.90	534.20	1066.10
431.40	492.50	516.40	535.00	1144.90
435.00	493.40	517.40	535.90	1917.00
459.30	493.40	520.00	538.10	1950.80
472.50	493.70	520.00	547.40	
475.00	494.00	522.60	551.00	
478.70	497.80	523.10	557.60	
480.00	497.90	524.50	561.50	
483.00	498.80	525.00	561.60	

INTER-LABORATORY STUDY 480

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 9 **** WITH OUTLIERS REMOVED ****

N	68	RANGE	1129.40	C.I.(UPPER)	554.56
TRUE-VALUE	498.04	VARIANCE	29591.55	C.I.(LOWER)	472.79
MEAN	513.67	STD. DEV.	172.02	SKEWNESS	.85
MEDIAN	505.90	COEF. VAR.	33.49	ACCURACY	1.56

DATA IN ASCENDING ORDER

15.50	483.00	497.90	523.10	551.00
83.20	483.00	498.80	524.50	557.60
129.60	485.40	499.20	525.00	561.50
176.80	488.30	500.00	525.30	561.60
253.40	488.80	502.90	527.00	575.00
299.10	490.00	505.70	528.60	594.00
415.60	490.50	505.90	529.00	598.00
431.40	492.30	510.50	530.00	647.90
435.00	492.50	511.90	530.60	950.00
459.30	493.40	516.40	534.20	988.10
472.50	493.40	517.40	535.00	1066.10
475.00	493.70	520.00	535.90	1144.90
478.70	494.00	520.00	538.10	
480.00	497.80	522.60	547.40	

INTER-LABORATORY STUDY 1080

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 1

N	69	RANGE	1514.30	C.I.(UPPER)	871.76
TRUE-VALUE	746.60	VARIANCE	66512.71	C.I.(LOWER)	750.06
MEAN	810.91	STD. DEV.	257.90	SKEWNESS	2.46
MEDIAN	759.30	COEF. VAR.	31.80	ACCURACY	1.70

DATA IN ASCENDING ORDER

352.00	718.30	752.60	773.50	816.90
446.10	725.00	754.10	783.80	821.00
543.50	725.40	754.60	791.10	826.80
565.00	726.30	756.20	792.60	831.80
568.40	734.10	757.80	793.00	841.80
598.50	738.00	758.50	800.00	900.70
600.10	743.00	759.30	801.20	1006.00
605.00	743.30	760.00	806.30	1020.00
657.10	747.00	761.50	806.40	1467.40
687.50	749.00	763.70	809.30	1571.00
696.60	750.00	764.30	811.60	1622.20
707.20	750.20	764.50	812.00	1700.00
716.00	750.50	766.70	812.50	1866.30
717.50	750.50	770.00	812.70	

INTER-LABORATORY STUDY 1080

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 1 **** WITH OUTLIERS REMOVED ****

N	65	RANGE	1115.40	C.I.(UPPER)	790.00
TRUE-VALUE	746.60	VARIANCE	18631.79	C.I.(LOWER)	723.64
MEAN	756.82	STD. DEV.	136.50	SKEWNESS	1.61
MEDIAN	757.80	COEF. VAR.	18.04	ACCURACY	1.50

DATA IN ASCENDING ORDER

352.00	718.30	752.60	773.50	816.90
446.10	725.00	754.10	783.80	821.00
543.50	725.40	754.60	791.10	826.80
565.00	726.30	756.20	792.60	831.80
568.40	734.10	757.80	793.00	841.80
598.50	738.00	758.50	800.00	900.70
600.10	743.00	759.30	801.20	1006.00
605.00	743.30	760.00	806.30	1020.00
657.10	747.00	761.50	806.40	1467.40
687.50	749.00	763.70	809.30	
696.60	750.00	764.30	811.60	
707.20	750.20	764.50	812.00	
716.00	750.50	766.70	812.50	
717.50	750.50	770.00	812.70	

INTER-LABORATORY STUDY 108C

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 4

N	71	RANGE	2165.00	C.I.(UPPER)	1042.77
TRUE-VALUE	895.90	VARIANCE	109199.17	C.I.(LOWER)	889.04
MEAN	965.91	STD. DEV.	330.45	SKEWNESS	8.10
MEDIAN	916.50	COEF. VAR.	34.21	ACCURACY	2.08

DATA IN ASCENDING ORDER

116.00	863.70	909.30	940.70	992.60
454.00	870.30	910.80	945.00	1014.00
534.50	881.50	911.60	949.60	1036.10
673.40	882.90	912.90	950.80	1072.00
675.60	884.20	914.50	952.30	1125.30
740.70	887.00	914.50	957.30	1286.80
742.00	887.20	917.00	960.00	1875.70
757.70	889.00	918.50	966.00	1913.10
779.50	890.00	920.20	966.00	1948.90
781.90	890.30	922.60	972.60	2100.00
801.40	894.00	925.00	973.80	2281.00
802.00	896.40	931.20	974.10	
821.40	898.50	932.40	976.00	
822.10	902.20	932.50	981.50	
845.00	908.80	940.00	982.10	

INTER-LABORATORY STUDY 108C

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 4 **** WITH OUTLIERS REMOVED ****

N	66	RANGE	1170.80	C.I.(UPPER)	928.58
TRUE-VALUE	895.90	VARIANCE	23281.20	C.I.(LOWER)	848.96
MEAN	885.77	STD. DEV.	152.58	SKEWNESS	-2.18
MEDIAN	912.25	COEF. VAR.	17.23	ACCURACY	1.82

DATA IN ASCENDING ORDER

116.00	845.00	902.20	932.40	974.10
454.00	863.70	908.80	932.50	976.00
534.50	870.30	909.30	940.00	981.50
673.40	881.50	910.80	940.70	982.10
675.60	882.90	911.60	945.00	992.60
740.70	884.20	912.90	949.60	1014.00
742.00	887.00	914.50	950.80	1036.10
757.70	887.20	914.50	952.30	1072.00
779.50	889.00	917.00	957.30	1125.30
781.90	890.00	918.50	960.00	1286.80
801.40	890.30	920.20	966.00	
802.00	894.00	922.60	966.00	
821.40	896.40	925.00	972.60	
822.10	898.50	931.20	973.80	

INTER-LABORATORY STUDY 1080

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 6

N	70	RANGE	761.90	C.I.(UPPER)	312.18
TRUE-VALUE	248.90	VARIANCE	12661.42	C.I.(LOWER)	259.46
MEAN	285.82	STD. DEV.	112.52	SKEWNESS	3.91
MEDIAN	254.15	COEF. VAR.	39.37	ACCURACY	2.91

DATA IN ASCENDING ORDER

191.00	244.50	252.60	264.60	288.80
207.00	245.10	252.80	265.30	290.00
224.00	247.00	253.20	265.30	291.10
224.50	247.10	254.90	266.50	333.10
234.80	248.00	256.00	267.30	467.00
235.70	248.00	256.30	267.50	484.60
236.00	248.20	256.30	268.40	532.40
236.30	248.50	256.60	268.70	599.30
238.20	249.40	256.90	270.00	620.00
238.70	250.00	258.00	272.00	952.90
240.00	250.40	259.00	272.80	
241.70	250.90	260.10	274.20	
243.70	251.40	260.80	280.70	
244.20	251.50	262.80	286.00	
244.50	252.50	262.90	286.70	

INTER-LABORATORY STUDY 1080

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 6 **** WITH OUTLIERS REMOVED ****

N	67	RANGE	341.40	C.I.(UPPER)	279.14
TRUE-VALUE	248.90	VARIANCE	2922.57	C.I.(LOWER)	253.25
MEAN	266.19	STD. DEV.	54.06	SKEWNESS	3.46
MEDIAN	254.90	COEF. VAR.	20.31	ACCURACY	2.41

DATA IN ASCENDING ORDER

191.00	244.50	251.50	260.80	274.20
207.00	244.50	252.50	262.80	280.70
224.00	245.10	252.60	262.90	286.00
224.50	247.00	252.80	264.60	286.70
234.80	247.10	253.20	265.30	288.80
235.70	248.00	254.90	265.30	290.00
236.00	248.00	256.00	266.50	291.10
236.30	248.20	256.30	267.30	333.10
238.20	248.50	256.30	267.50	467.00
238.70	249.40	256.60	268.40	484.60
240.00	250.00	256.90	268.70	532.40
241.70	250.40	258.00	270.00	
243.70	250.90	259.00	272.00	
244.20	251.40	260.10	272.80	

INTER-LABORATORY STUDY 108C

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 7

N	70	RANGE	1200.90	C.I.(UPPER)	591.35
TRUE-VALUE	497.70	VARIANCE	34017.05	C.I.(LOWER)	504.94
MEAN	548.15	STD. DEV.	184.44	SKEWNESS	2.46
MEDIAN	513.75	COEF. VAR.	33.65	ACCURACY	3.22

DATA IN ASCENDING ORDER

118.00	492.30	510.00	532.00	578.50
270.00	496.00	512.10	532.10	579.90
295.70	496.50	512.50	532.30	590.20
395.00	497.20	513.00	533.40	601.70
416.70	499.30	513.30	534.40	696.40
434.10	499.80	514.20	534.80	914.60
449.30	501.80	514.80	535.00	1004.90
460.80	503.00	517.80	540.00	1200.00
467.00	506.30	522.00	540.50	1238.60
469.70	506.40	523.70	540.60	1318.90
471.80	507.90	524.40	546.80	
476.80	507.90	529.00	550.10	
479.30	508.10	529.30	552.00	
482.60	508.20	529.60	556.50	
490.30	508.90	532.00	572.00	

INTER-LABORATORY STUDY 108O

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 7 **** WITH OUTLIERS REMOVED ****

N	67	RANGE	886.90	C.I.(UPPER)	542.72
TRUE-VALUE	497.70	VARIANCE	11891.47	C.I.(LOWER)	490.50
MEAN	516.61	STD. DEV.	109.05	SKEWNESS	1.08
MEDIAN	513.00	COEF. VAR.	21.11	ACCURACY	3.07

DATA IN ASCENDING ORDER

118.00	490.30	508.20	529.30	550.10
270.00	492.00	508.90	529.60	552.00
295.70	496.00	510.00	532.00	556.50
395.00	496.50	512.10	532.00	572.00
416.70	497.20	512.50	532.10	578.50
434.10	499.30	513.00	532.30	579.90
449.30	499.80	513.30	533.40	590.20
460.80	501.80	514.20	534.40	601.70
467.00	503.00	514.80	534.80	696.40
469.70	506.30	517.80	535.00	914.60
471.80	506.40	522.00	540.00	1004.90
476.80	507.90	523.70	540.50	
479.30	507.90	524.40	540.60	
482.60	508.10	529.00	546.80	

INTER-LABORATORY STUDY 1080

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 9

N	69	RANGE	355.70	C.I.(UPPER)	123.20
TRUE-VALUE	99.54	VARIANCE	2604.36	C.I.(LOWER)	99.12
MEAN	111.16	STD. DEV.	51.03	SKEWNESS	2.95
MEDIAN	99.10	COEF. VAR.	45.91	ACCURACY	-.44

DATA IN ASCENDING ORDER

30.30	90.00	95.20	104.30	118.10
42.40	90.70	95.30	105.00	120.00
51.70	90.80	95.40	105.50	123.50
64.10	91.20	96.50	105.90	130.70
76.30	91.20	97.20	106.40	132.50
77.20	91.60	98.30	106.80	142.00
83.00	93.30	99.10	108.60	167.60
83.30	93.50	99.20	109.60	200.40
84.60	93.60	99.40	110.00	213.80
85.50	94.00	100.00	110.20	215.00
86.30	94.00	100.10	110.50	236.40
86.30	94.20	100.40	114.40	250.00
86.40	94.80	100.70	116.00	386.00
88.80	95.10	101.80	118.00	

INTER-LABORATORY STUDY 1080

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 9 **** WITH OUTLIERS REMOVED ****

N	67	RANGE	206.10	C.I.(UPPER)	113.31
TRUE-VALUE	99.54	VARIANCE	1208.00	C.I.(LOWER)	96.66
MEAN	104.99	STD. DEV.	34.76	SKEWNESS	1.81
MEDIAN	98.30	COEF. VAR.	33.11	ACCURACY	-1.25

DATA IN ASCENDING ORDER

30.30	90.00	95.20	104.30	118.10
42.40	90.70	95.30	105.00	120.00
51.70	90.80	95.40	105.50	123.50
64.10	91.20	96.50	105.90	130.70
76.30	91.20	97.20	106.40	132.50
77.20	91.60	98.30	106.80	142.00
83.00	93.30	99.10	108.60	167.60
83.30	93.50	99.20	109.60	200.40
84.60	93.60	99.40	110.00	213.80
85.50	94.00	100.00	110.20	215.00
86.30	94.00	100.10	110.50	236.40
86.30	94.20	100.40	114.40	
86.40	94.80	100.70	116.00	
88.80	95.10	101.80	118.00	

APPENDIX D: INSTRUCTIONS FOR USE OF THE AUDIT MATERIALS

INSTRUCTIONS FOR USE OF ENVIRONMENTAL PROTECTION AGENCY METHOD 5 DRY GAS METER PERFORMANCE TEST DEVICE

NOTE: All procedures referrred to are from revised Method 5 published in the Federal Register, Vol. 12, No. 160, Part II, Thursday, August 18, 1977, pp. 41776-41782 and references contained therein. This revised method should be adhered to in all details in the use of this quality assurance performance device.

EQUIPMENT: The participant in this study should possess the following equipment, including the performance test device supplied by EPA.

Quantity	Item
1	Method 5/Source Sampling Meter Box
1	Stopwatch, preferably calibrated in decimal minutes
1	Thermometer, ambient range
1	Barometer. If unavailable, call nearest National Weather Service and request the ABSOLUTE barometric pressure. (Corrected for temperature and acceleration due to gravity, but not corrected for altitude.)
1	Performance Test Device. A calibrated flow orifice housed in a quick-connect coupling and identified with an engraved three-digit serial number. WARNING: THE DEVICE MUST NOT BE DISASSEMBLED UNDER ANY CIRCUMSTANCES. Use these devices at room temperature.

PROCEDURE:

1. Remove the performance test device from its case and insert it into the gas inlet quick-connect coupling on the source sampling meter box.
2. Turn the power to the meter box on and start the pump.
3. Adjust the coarse flow rate control valve and the fine flow rate control valve to give a maximum vacuum reading. CAUTION: A vacuum reading of less than 17 inches Hg will result in flow rate errors.
4. Allow the orifice and source sampling meter box to warm up for 45 minutes with flow controls adjusted as described in Step 3 before starting quality assurance runs.
5. Make triplicate quality assurance runs. For each run, record initial and final dry gas meter volumes, dry gas meter inlet and outlet temperatures, internal orifice pressure drop (ΔH), ambient temperature, and barometric pressure. Run duration should be slightly greater than 15 minutes. The following procedure is recommended. Fifteen minutes after a run is started, the participant watches the dry gas meter needle closely. As the needle reaches the zero (12 o'clock) position, the pump and stopwatch are stopped simultaneously. The dry gas meter volume and time are recorded.
   This complete run procedure is performed three times to provide the required triplicate quality assurance runs.
6. Calculate the corrected dry gas volume for each run using equation 5.1 of the above-referenced Method 5. For each replicate, record the corrected dry gas volume in dry standard cubic meters, the sampling time in decimal minutes, the barometric pressure in mm Hg, and the ambient temperature in degrees Celcius on the enclosed data card. Be sure to record the performance test device serial number on the data card in the column headed "Orifice Number."
   NOTE 1: If you calculate dry gas volume in English Units, use the conversion factor of 0.02832 m^3 ft^3 to obtain the volume in metric units.
   NOTE 2: If your stopwatch is not in decimal minutes, be sure to convert (e.g. 15 minutes 20 seconds is reported as 15.33 minutes)
7. After recording the requested data on the enclosed data form, return the data form and the performance test device to:

   Quality Assurance Division (MD-77)
   Environmental Monitoring Systems Laboratory
   Environmental Protection Agency
   Research Triangle Park, North Carolina 27711
   Attention: Robert G. Fuerst

   A postpaid return envelope and label are enclosed for this purpose.

INSTRUCTIONS FOR USE OF ENVIRONMENTAL PROTECTION AGENCY STATIONARY SOURCE QUALITY ASSURANCE SO_2 REFERENCE SAMPLES

Note: All Method 6 procedures referred to are from the amended method published in the *Federal Register* Vol. 42, No. 160, Part II, Thursday, August 18, 1977, pp 41782-41784. This amended method should be adhered to in all details in the analysis of these reference standards.

1. Prepare 3-percent hydrogen peroxide according to Section 3.1.3 of the method (30 ml is required for each sample and each blank).

2. Prepare each reference sample for analysis as follows: Wrap a paper towel around the ampule and with the ampule in an upright position break off the top at the prescored mark by exerting pressure sideways. From the ampule pipette exactly 5 ml of the reference sample into a 100-ml volumetric flask. Add 30 ml of 3-percent hydrogen peroxide solution. Dilute exactly to the mark with deionized, distilled water. Analyze the sample in accordance with the procedure detailed in Section 4.3 of the method, beginning with "Pipette a 20-ml aliquot of this solution. . . ." (Note: If more than 50 ml of barium perchlorate titrant is required for any sample analysis, a smaller aliquot should be selected to allow titration with less than 50-ml titrant.)

3. Calculate the concentration, C_{SO_2} (concentration of sulfur dioxide, dry basis, corrected to standard conditions, mg/dscm), using Equation 6-2. A value of 21 X 10^{-3} dscm should be used for V_m(std), in the equation. A value of 100 ml should be used for V_{soln} in the equation.

4. Record the reference standard sample numbers and their corresponding SO_2 concentrations in mg/dscm on the enclosed data form. Return the form to:

Quality Assurance Division (MD 77)
Environmental Monitoring Systems Laboratory
Environmental Protection Agency
Research Triangle Park, N.C. 27711
Attn: Robert G. Fuerst

If other than EPA Method 6 is used for your analyses, please explain in detail your analytical procedure on the back of the enclosed data form.

INSTRUCTIONS FOR USE OF ENVIRONMENTAL PROTECTION AGENCY STATIONARY SOURCE QUALITY ASSURANCE NO_x REFERENCE SAMPLES

Note: All Method 7 procedures referred to are from the amended method published in the *Federal Register* Vol. 42, No. 160, Part II, Thursday, August 18, 1977, pp 41784-41786. This amended method should be adhered to in all details in the analysis of these reference standards.

1. Prepare absorbing solution according to Section 3.1 of the method.

2. Prepare each reference sample for analysis as follows: Wrap a paper towel around the ampule and with the ampule in an upright position break off the top at the prescored mark by exerting pressure sideways. From the ampule pipette exactly 5 ml of the reference sample into a 100-ml beaker. Add 25 ml absorbing solution to the beaker; adjust the pH to 9-12 (using pH paper as indicated in Section 4.2 of the method) by dropwise addition of sodium hydroxide (1N). Quantitatively transfer the contents of the beaker to a 50-ml volumetric flask and dilute exactly to the mark with deionized, distilled water. Mix thoroughly and pipette a 25-ml aliquot of the diluted sample into a porcelain evaporating dish. Beginning with the evaporation step in Section 4.3, complete the sample analysis.

3. Calculate total μg NO_2 per sample using Equation 7-3. Calculate the sample concentration, C (concentration of NO_x as NO_2, dry basis, corrected to standard conditions, mg/dscm), using Equation 7-4. A value of 2000 ml should be used for V_{sc} in Equation 7-4.

4. Record the reference sample numbers and their corresponding concentrations, C, in mg/dscm on the enclosed data form. Return the form to:

Quality Assurance Division (MD 77)
Environmental Monitoring Systems Laboratory
Environmental Protection Agency
Research Triangle Park, N.C. 27711
Attn: Robert G. Fuerst

If other than EPA Method 7 is used for your analyses, please explain in detail your analytical procedure on the back of the enclosed data form.